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RAW MILK MENACE
IN KANSAS CITY



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SPECIAL REPORT

on

RAW MILK MENACE

IN KANSAS CITY, KANSAS

AUGUST, 1941

by the

DEPARTMENT OF HEALTH

KANSAS CITY, KANSAS



GEO. T. DARBY

COMMISSIONER OF FINANCE,
HEALTH AND PUBLIC PROPERTY

RAGNAR T. WESTMAN, M. D., DR. P. H., F. A. P. H. A.
DIRECTOR OF HEALTH

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To the Honorable Board of City Commissioners,
Kansas City, Kansas -

A SPECIAL REPORT ON
THE RAW MILK MENACE
IN KANSAS CITY, KANSAS

By

Ragnar T. Westman, S.B., M.B., M.D., M.P.H.; Dr. P.H.; F.A.P.H.A.
Director of Health, Kansas City, Kansas

People are becoming sick with undulant fever from raw milk being sold in this city. The Kansas State Board of Health Laboratory continues to find the germ of undulant fever in raw milk from producers serving our community. Eighty-two cases of undulant fever were reported to our department of health in 1940, and already fifteen additional cases have been reported in 1941. We certainly have the duty of at least safeguarding the milk supply for the protection of our own residents.

The responsibility of providing a safe, pure milk has been increased, now that Kansas City, Kansas has been declared a Defense Area, and awaits an influx of new defense workers. The United States Public Health Service cannot condone such a dangerous condition in a defense area. One Public Health Service physician went so far as to say, "It is actually criminal negligence to allow people to become ill with undulant fever, especially since it can be so easily prevented by safeguarding the milk supply."

As the Board of Commissioners knows, the Department of Health has been endeavoring to improve the milk supply for some time. We have not been entirely unsuccessful, for we have induced seventeen dairies to install pasteurizers, thereby increasing the percentage of safe pasteurized milk sold in the city from fifty per cent a year ago to almost ninety per cent today. But so far we have been unsuccessful in safeguarding the remaining ten per cent of milk sold in the city, because a handful of raw milk dairymen refused to protect the public health by either testing their herds and removing their infected cows, or pasteurizing their milk. Indeed, they started law-suits and initiated a restraining order against the city to stop the milk improvement program.

The city won when the restraining order against it was dissolved in February, 1941, but the Court cast some doubt on the phraseology of one clause in the milk ordinance. The milk ordinance must be amended before it may be properly enforced. The amendment has been drawn and approved by the city Legal Department, and awaits presentation to your Honorable Board. This special report is being presented in order that the Board may have the true facts when considering the proposed amendment. It is moreover the duty of the Director of Health to call this unhealthful condition to your attention.

Of course the average citizen, no matter how intelligent he may be, is not in a position to clearly understand the true situation. He is naturally confused when he hears a divergence of opinion which he cannot test for himself. The Department of Health has repeatedly warned that raw milk in this city is spreading undulant fever, and advises that raw milk should be boiled until such time as it can be reasonably safeguarded. But the raw milk dairymen, naturally anxious to sell their product without added expense, counter by saying that the health department is politically controlled to drive the small dairyman out of business. They even go so far as to deny that there is such a thing as undulant fever, or at least that it may be spread by raw milk scientific proof to the contrary notwithstanding. Whom shall the milk consumer believe? It is not until his raw milk consuming neighbor contracts undulant fever that he realizes the truth. And by that time it may be too late to prevent the disease in his own family. To corroborate our stand we are reproducing here articles from the scientific literature. This literature is very voluminous and so we can include only a few articles which we happen to have in our library.

These cases of undulant fever which have been reported occurred in persons who either had never heard of the disease, or believed that it could not happen to them. But it did. We humans are prone to believe that it will always be the other fellow who will be affected, and not us.

Imagine how they must have felt when they got it. Consider the prominent attorney whose daughter had undulant fever for three years. He didn't half believe that she had it, but since the family physician said it was due to using raw milk he stopped buying raw milk for his family. But he continued to buy raw cream from the same dairyman, not knowing that raw cream carries even more undulant fever germs than raw milk. Anyhow, he didn't believe it could happen to him. But it did. Imagine how he felt lying there in the hospital with severe headache, backache, high fever, severe chills, profuse perspiration, great fatigue and nervousness. Laboratory tests showed that he, too, had undulant fever. He really hadn't thought much about undulant fever before.

You see, he was an educated man. He was always careful about himself and family, always used the best of everything. But he listened to the propaganda of the raw milk dairyman who said that raw milk was better because it was "natural", and unchanged. That sounded logical. He didn't know that about fifty epidemics of disease are reported every year in the United States, due to using raw milk. Many more occur which are not reported. Not only undulant fever, but typhoid fever, scarlet fever, diphtheria, dysentery, food poisoning, and even infantile paralysis have been spread by raw milk. More diseases are spread by using raw milk than by any other food. And he didn't know that pasteurization of

milk not only completely safeguards milk against these milk-borne diseases, but it does so without being changed in taste, cream-line, vitamin or food value. And so he got undulant fever from using raw milk. The disease settled in the valves of his heart, and he died July 13, 1940.

The State Board of Health investigated the dairy which sold him the raw cream. Out of fourteen cows in the dairy, eight were found to be infected with Bang's disease, the disease in cows which is spread by raw milk to cause human undulant fever. Even the germ itself which causes **this** condition, known as the *Brucella abortus*, was found in the milk from four of these cows.

Consider now the music teacher in one of our high schools. Imagine how he must have felt when he lay in the hospital with high fever, chills, profuse perspiration, aches and pains, great prostration. Imagine how he felt when the undulant fever became complicated with pneumonia and it looked as though he were going to die. The laboratory found the germ of undulant fever in his blood, the germ being the type that comes only from Bang's infected cows. Investigation revealed three Bang's infected cows at the dairy from which he obtained his raw milk. The music teacher didn't die, but he is still so sick that he cannot return to work. He hasn't worked for a year. Think how expensive undulant fever was to him with hospital bills and everything.

Consider now the business college student who a few years ago became ill with sore throat, chills, high fever, drenching sweats, and delirium. He became mentally unbalanced, becoming excited, violent, and noisy, completely disoriented as to where or who he was. Finally he became so bad that he had to be admitted to the state hospital for the insane. He was hallucinated and destructive of clothing and bedding, and was frequently nude. The laboratory tests for undulant fever were extraordinarily strong, and tests for other diseases were negative. His insanity was due to undulant fever. Fortunately, he recovered mentally when his undulant fever was treated. He was a heavy drinker of raw milk. The raw milk dairy from which he obtained his milk was shown to have Bang's infected cows in the herd. Imagine how this young man felt going through all this terrible illness.

Consider the three year old boy who became so violently ill with undulant fever that it was first thought that he had the dreaded disease, acute leukemia. Laboratory tests were exceedingly strong for undulant fever. When specific anti-undulant fever serum was injected into him, he became well almost over night. Imagine how his parents must have felt, watching him, thinking that he might die, knowing that this could have been prevented had they used pasteurized milk instead of raw milk. Two Bang's infected cows were found in the herd supplying raw milk to this boy. This dairy also sold milk in Kansas City, Missouri. Testing the cows at intervals, as required by that city, was not enough protection.

And consider the hundreds of cases, both reported and not reported to us, who continue to have chronic undulant fever for years, becoming semi-invalids, continuing to work only with difficulty. Undulant fever is not a pleasant disease. Any person who has it will tell you that he would not wish it on his worst enemies. Many cases of arthritis are in reality due to undulant fever. Hodgkins disease, a cancer-like condition, may be due to chronic undulant fever for the germ of undulant fever has been repeatedly found in the enlarged lymph nodes of Hodgkin's disease.

There can be no doubt that all these cases of undulant fever were due to raw milk, with the possible exception of a dairy man's wife, two veterinarians, and a meat packing worker who, though they used raw milk, might have acquired their infections directly from cows or hogs. It is certainly no coincidence that all of the cases used raw milk. This Department of Health, in cooperation with the Kansas State Board of Health, tested the 74 raw milk dairies serving this city in 1940, and among this number found that 72 dairies had Bang's infected cows in their herds. Some herds had as high as 60 per cent of the cows infected. Of the total number of cows tested, an average of twenty per cent were infected. Nor is this all, for the State Board of Health frequently found the germ itself of undulant fever in the raw milk from these dairies. And it is continuing to find the germ in raw milk in this city today.

Undulant fever is not a new disease in this state or city. The first cases in the state were reported in 1927 by Major C. C. Hillman of the United States Army Medical Corps at Fort Riley. Since that time a total of more than eleven hundred cases and forty-five deaths, attributed to the disease have been reported in this state. This is an average of eighty cases and three deaths a year. But the reported incidence of the disease has steadily increased so that one hundred sixty-five cases were reported in 1940. Undulant fever is an important disease in Kansas largely because we are a dairy state in which much raw milk is sold. However, not all these cases in the state were due to raw milk, since some of them were acquired directly from animals.

The first recorded mention of the existence of undulant fever in Kansas City, Kansas, appeared in an article by Dr. Fred E. Angle of this city in the Journal of the Kansas Medical Society of October, 1929, when ten cases were reported. Six years later the same physician reported in the Journal of the American Medical Association of September 2, 1935 that he had treated one hundred cases of undulant fever. Some of these cases were non-residents. In the Annals of Internal Medicine of June, 1937, Drs. Angle and Algie describe how a Kansas City resident became insane from his undulant fever infection and had to be admitted to the insane asylum. These physicians noted that their cases were users of raw milk. In the Annals of Internal Medicine of October, 1938, Drs. Angle, Algie, Baumgartner, and Lunsford gave the results of a skin testing survey for undulant fever done on Kansas City, Kansas, school children. It should be noted that Dr. Baumgartner represented the United States Public Health Service, and that Dr. Lunsford was then the Director of Health of Kansas City, Kansas. It was found that nine per cent of the children reacted positively to the test and subsequent investigations revealed that many of them actually had some of the manifest symptoms of the disease. Investigation further showed that these positive reactors were using raw milk or had used it in the past. Routine blood tests on adult patients in this city show that about seven per cent of adults have a positive reaction for undulant fever to some degree. Undulant fever is therefore neither a new or a rare disease in Kansas City.

One can only wonder at the audacity and stone-heartedness of the handful of raw milk men who see undulant fever cases develop on their milk routes, yet refuse to test their herds and remove their positive reactors. How these non-resident, non-voting, non-tax-paying raw milk men have the nerve to continue to distribute the stuff in our city is more than the average citizen can understand.

To further confuse the issue some of these raw milk men have deliberately vaccinated their entire herds against Bang's disease, adult cows as well as calves, despite the fact that the United States Department of Agriculture, the Kansas State Livestock Sanitary Commissioner, and this Department of Health have repeatedly stated that vaccination of adult cows is of no value in safeguarding milk, and have advised against it. The vaccination of adult cows causes the blood test for Bang's disease to become positive so that one can not tell whether the animal is infected with Bang's disease, and therefore dangerous, or whether it is only a vaccination reaction. Some of these vaccinated animals continue to have a positive test for Bang's disease for life. These raw milk men, contrary to our advice, have been deliberately contacting other raw milk men urging them to vaccinate their herds also. Their hope has been to have so many vaccinated herds with positive tests for Bang's disease that we would not dare to enforce the milk ordinance. But in this attempt they were unsuccessful since only a few other dairymen vaccinated their herds.

On March 8, 1941 we wrote to Dr. John R. Mohler, Chief of the Bureau of Animal Industry, United States Department of Agriculture, briefly outlining our testing requirements, and asking his official opinion of the value of vaccination of calves and adult cows against Bang's disease. We quote the reply in full as follows:

"UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF ANIMAL INDUSTRY

Dear Sir:

This will acknowledge your letter of March 8, requesting information relative to the part that vaccination of cattle may play in connection with providing a safe milk supply for your city.

It is believed that your ordinance is reasonable and should not work an undue hardship on the cattle owners. It would, no doubt, be beneficial as a public health measure in the elimination of animals that react to the Bang's disease test, as quite a number of such animals frequently expel *Brucella abortus* from their udders during their lactation period.

The Bureau does not recognize the use of *Brucella abortus* vaccine in animals more than eight months of age and considers it of no value in treating animals affected with Bang's disease.

There is enclosed a copy of a paper delivered by Dr. John R. Mohler, Chief of Bureau, on December 5 before the United States Livestock Sanitary Association meeting in Chicago, Illinois, from which it is thought you will be able to obtain a great deal of valuable information concerning Bang's disease and the use of *Brucella abortus* vaccine.

Very truly yours,

(Signed)

A. W. Miller
Acting Chief of Bureau."

We quote a few pertinent passages from this paper:

"It was found that vaccines of no kind had any curative effect in infected cattle.....

"Later studies by the Bureau of vaccination with virulent cultures in open adult animals showed that in many instances the vaccine localized in the udder and that such animals were made chronic carriers of the organism."

"Dairymen who seek the vaccination of their adult cattle with or without vaccination of their calves should be warned that the number of city and town health officers who are requiring milk from non-reacting cattle for their citizens is constantly on the increase. Too frequently have we learned that such owners have been deprived of their markets because their vaccinated cows had continued to react following vaccination. Moreover, regulations in a number of States require that cattle destined to such States must not be reactors to the blood test. Therefore, shippers of both dairy and beef cattle should be properly advised against promiscuous vaccination without supervision, before they risk shipments in violence to the regulations of the State at destination."

"The vaccination of all animals should be confined to calves between four and eight months of age and this should be accomplished as nearly as possible during the sixth month of the animals life."

"An animal in a herd where vaccination is practiced should not be disposed of for any purpose other than immediate slaughter while revealing a positive titer, except upon written permission by the cooperating State or Bureau officials."

"A herd under the vaccinal plan may be certified as a HERD FREE OF BRUCELLOSIS for a period of one year when all animals in the herd over two years of age reveal at least two negative reactions to official blood agglutination tests properly spaced, when non-vaccinated heifers under two years shall similarly be proved negative to the test, and when vaccinated heifers under two years either show a satisfactory decline in titer or are removed for slaughter."

Vaccination of calves is not a method of safeguarding milk. Calfhood vaccination appears to be of some value in preventing abortions when the calf becomes an adult, but does not prevent Bang's disease infection and contamination of milk with undulant fever germs. Calfhood vaccination is, therefore, chiefly of value to the dairyman himself because more calf offsprings will be obtained.

We asked the Kansas office of the United States Department of Agriculture for advice on our undulant fever problem. Dr. Ralph Graham, in charge, visited our city, talked to Raw milk dairymen here, examined our milk ordinance, and analyzed our milk improvement program. We quote his report in full as follows:

"UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF ANIMAL INDUSTRY
LOCAL OFFICE

204 Federal Building
Topeka, Kansas
May 8, 1941

Mr. George T. Darby
Commissioner of Finance, Health and Public Property
Kansas City, Kansas

Sir:

In reply to your request for information and advice regarding the Bang's disease control program of your city. I should like to state that I believe your program is reasonable and practicable for the dairymen and, at the same time, it offers a reasonable protection to the public health of your community.

Under your City Milk Ordinance the dairymen have a choice of two procedures, either test their herds and remove all cows which react to the agglutination test for Bang's disease or, pasteurize all the milk. It appears as if it would be reasonable to require the dairymen who desire to supply raw milk to retest their herds every three months. They will find that this is also profitable from a production standpoint as, reacting cows do not produce as much as those which are negative to the test. It is impossible to distinguish by the agglutination test between the naturally infected cattle and those which have been vaccinated against Bang's disease. Therefore, in order to protect health, raw milk from such reactors should not be marketed.

A practical solution in your community would appear to be to permit the vaccination of calves between the ages of 4 and 8 months (preferably during the sixth month) to be raised as replacements of the older cows. It is not recommended to vaccinate any cattle more than 8 months of age.

I might suggest a plan as adopted by some other dairy localities to handle similar situations. Due to the fact that infected herds do not produce sufficient calves to make a rapid replacement of the old herd, some dairymen have adopted the plan of buying heifer calves from 4 to 8 months of age and having them vaccinated. In this manner it does not take long to build up their herds as, sufficient calves can be purchased during the first and second year to replace the entire old herd. These calves, of course, to be tested at the age of 18 months and any showing a positive reaction to the agglutination test to be eliminated before they are put into the milk line. This appears to me to be the most practical method of handling such a situation.

RG:g

Respectfully
Ralph Graham, Inspector in Charge
BANG'S DISEASE CONTROL

The proposed amendment to the milk ordinance embodies the suggestions made by Dr. Ralph Graham in his letter. The highest authorities in the land on undulant fever and Bang's disease are the United States Public Health Service and the United States Department of Agriculture. The State Board of Health and the State Livestock Sanitary Commission are guided by them in this matter. Hence we know that we are doing the right thing in adopting this amendment to the milk ordinance.

It will be noted that Dr. Graham states that it is impossible to distinguish by the agglutination test between the naturally infected cattle and those which have been vaccinated against Bang's disease, and therefore, in order to protect the public health, raw milk from such reactors should not be marketed. The cattle which have been vaccinated may be naturally infected with Bang's disease even though vaccinated.

The concensus of opinion is that testing for various diseases in cows, though helpful, is not a complete protection, no matter how often tests are made. Tests often do not detect disease in cattle actually present. Disease may be spread between tests. Diseases not tested for may be transmitted. Numerous authorities have stated that raw milk is never safe, and that pasteurization is the only complete safeguard. Very occasionally a pasteurizer may break down, for nothing in this world is perfect, but by comparison with other safeguards, pasteurization is the best safeguard against all milk-borne diseases. This is the conclusion of epidemiologists, public health leaders, and physicians everywhere. The United States Government permits only pasteurized milk to be served to its Army, Navy, and other armed forces.

The idea still prevails among the laity that when a dairyman has a clean looking dairy and is apparently careful to produce his product in a clean manner it will be safe. This idea arose from the old belief that disease was spread through filth. Among health officials it has been recognized for more than a quarter century that diseases are spread mainly through material from previous cases in the form of living germs. It is not a question of "filth" at all. The repeated spread of epidemics through raw certified milk is the best evidence that the extreme care and cleanliness used in the production of certified milk will not alone make raw milk safe. Today Medical Milk Commissions are urging that even certified milk be given the added protection of pasteurization.

No one can tell by just looking at a bottle of milk if it is safe to use. Just as an experiment, try mixing a teaspoonful of cow manure in a bottle of milk and see if you can detect any difference. Nor will there be any appreciable difference in taste, for the milk will only have that "good old raw milk flavor" you were used to as a child on the farm. The germs of disease are invisible and require practically no space at all. A teaspoonful of disease germs would most certainly prove fatal. There is only one sure safeguard for all milk, and that is to produce it as clean and pure as possible and then pasteurize it.

Even in this enlightened day of science, producers and distributors of raw milk are hammering at the credulous public with a propaganda designed to make one believe that raw milk is somehow better than pasteurized milk. Of course the purpose of this propaganda is to sell raw milk without the added expense of pasteurization. If a pasteurization apparatus were to cost only ten dollars, the raw milk industry would not fight pasteurization, but would itself adopt it. The fact that seventeen raw milk producers were able to install pasteurizing plants at their farm dairies indicates that the expense of such plants is not prohibitive. If the dairyman could not afford to install his own pasteurizer, he could at least have someone else pasteurize for him at low cost.

But we are not attempting to force the raw milk man to pasteurize his milk. According to our milk ordinance he has the choice of either testing his cattle and removing the positive reactors, or of pasteurizing his milk. The proposed amendment clearly provides that he may continue to sell raw milk, provided only that it be shown that he has no cattle on his dairy which react positively to the test for Bang's disease. No body is forcing anyone out of business. Surely the dairyman owes it to the public to provide a safe, pure milk.

The Wyandotte County Medical Society has by resolution approved our milk improvement program, has endorsed our efforts to require that cows be tested and shown to be free from Bang's disease, and recommends pasteurization of all milk as the best safeguard.

The vested interests of the raw milk industry are by law-suits, scandalous unscientific articles, and even political pressure attempting to intimidate public officials so that they will not do their duty to the public. As public officials we are sworn to protect the health and welfare of our community and must therefore stand up against such intimidation. Have we the fortitude to withstand such pressure, knowing that we are right, and follow the dictates of our consciences? We must if we are to do our duty and fulfill our responsibilities to the community.

In former years epidemics of diseases carried by water and milk were more frequently spread by water. But today no city would think of pumping raw river water with its contaminating sewage into the water mains of the city without first safeguarding it by a treatment process analagous to pasteurization. But that is just what cities used to do, and they had terrific epidemics of typhoid fever. But now water-borne epidemics are exceedingly rare, and occur usually in small communities from small individual untreated supplies, analagous to the numerous small untreated raw milk supplies we have today. More outbreaks today are due to raw milk than to water. Among all the foods, raw milk carries more outbreaks of disease than does any other single food. It would be unthinkable for a progressive city not to protect its water supply by

modern scientific treatment; indeed, it would be criminal. Likewise, the time is rapidly approaching when no city will allow its milk supply to stand unguarded.

We know that raw milk now being sold in the city is a menace to health. The State Board of Health continues to find the germ of undulant fever in raw milk, and people are getting sick from it. It is obviously our duty until such time as the milk can be safeguarded to warn the public and advise that the raw milk should be boiled before using, or use pasteurized milk instead. It is our duty to warn residents of surrounding cities, soldiers from nearby military encampments, defense workers, tourists, and others who may visit our city. As public officials it is our duty to give this warning. The public has the right to expect it.

But we hope that this will not be necessary much longer. We hope that your Honorable Board will adopt the amendment to the milk ordinance and give us your full support in enforcing it.

The United States Public Health Service no longer includes Kansas City, Kansas, on its list of cities having an approved milk supply. Adoption of the amendment to the milk ordinance and its enforcement are necessary before we may once more be approved.

On the following pages are reproduced articles by authorities on milk and milk-borne diseases. These articles prove that we are not alone in our stand. We say that raw milk is never truly safe, and should be pasteurized. So do they.



Underwood & Underwood

The RAW MILK MENACE

A malevolent masquerader like syphilis, brucellosis appears under many guises. Like syphilis, too, its incidence rate is unusually high—occurring in an estimated 10 per cent of our population.

By HAROLD J. HARRIS

Printed and Published in the United States of America

The RAW MILK MENACE

By **HAROLD J. HARRIS**

THE CONQUEST of disease during the comparatively short history of modern medicine has been largely a matter of learning how to ward off death in some of its more violent forms. Epidemics of virulent disease were a ghastly but effective kind of population control in the old days; they are rare now, fortunately, and limited in their effect. Scientists now have time to turn their attention to keeping the human race well, rather than just alive.

In recent years a disease little known and difficult to understand has begun to attract widespread attention. Not a new malady, its acute form was probably referred to by Hippocrates in his classical descriptions of disease written in the fourth century B. C. This disease took a real place in medical history when it swept through the ranks of the British army during the Crimean War, breaking out on the Island of Malta among soldiers who drank raw goats' milk. Sir David Bruce isolated the germ of "Malta Fever" in 1886, and countless other names were given it in an attempt to describe its locality, its nature or its course, among them Mediterranean fever, goat fever, dust fever. In 1895 British army doctor M. L. Hughes, noting how temperatures and other symptoms came and went, called it "undulant fever," a name still often used despite the scientists' more recent and descriptive term, "brucellosis."

The disease was studied in animals before its effect on man was fully understood. Not only goats, but cattle, pigs, horses and sheep were subject to it. The first human case was recognized in this country in 1904. It was not until the World War that Alice Evans, Senior Bacteriologist, Public Health Service, found that the germ as found in goat's milk was similar to that causing a widespread epidemic of contagious abortion in cattle and prophesied that it would prove dangerous to human beings. Nine years later Richard Kern, one of the few investigators then impressed by the importance of this disease, noted that thirty-six cases of human illness due to the abortus strain had been reported from widely scattered sections of the United States. He predicted more cases and a major public health problem arising

from the disease. Within two years there were 2,365 cases and six years later, 9,965. Statistics do not tell all the story, for cases were reported only from regions where there chanced to be doctors who understood and could diagnose the disease. Even now, adequate research is being carried on in but a few widely separated areas scattered over the country. Sample group testing seems to indicate that about 10 per cent of the population has become infected with the germ and cases have been reported from all over the civilized world. Of those infected about 1 per cent are actively ill; the rest, while harboring the germ in their tissues, may never develop serious illness, or if they do, it may be only evanescently following some depleting, resistance-destroying experience.

The disease occurs more frequently among country people than among city dwellers, and is contracted from the use of infected, raw milk or by handling infected animals or carcasses. Veterinarians, slaughter house employees and laboratory workers are grossly exposed to infection. It is reliably estimated that 20 per cent of the cattle of America, distributed among 46 per cent of the herds are now infected. Sheep, goats, horses, hogs and other domestic animals as well as wild rats are known to carry the infection, but it does not seem to be transmitted from one human to another. In the experience of a doctor with patients from farming regions, 51 per cent of 150 cases of arthritis reacted to the tests for brucellosis and 90 per cent of those treated recovered from their arthritis with undulant fever vaccine. The milk supply of cities may be protected by pasteurizing regulations, but people who drink raw milk while vacationing in the country are not protected. Even if the exposure from raw milk was years before, the disease still must be suspected for the body may harbor the germ for years.

Like syphilis, it is a great masquerader, appearing under many guises. Scarlet fever, measles, whooping cough and most other infectious diseases have a more or less typical mode of onset and group of symptoms. But two cases of brucellosis rarely act alike. Until quite recently only the acute form was recog-

nized. Since the introduction of more accurate tests, the chronic form is known to be far more common than the acute.

Usually the acute infection begins with a grip-like illness, of slow or rapid onset, with fever, chills, backache, headache, pains in joints and muscles, prostration, possibly sore throat, cough and even pleurisy, or with profuse sweating, often of unpleasant odor. Fever continuing beyond that of ordinary grip may suggest brucellosis, but early agglutination tests may be negative or weakly positive. Usually, in the acute illness, the blood reaction becomes positive within two weeks but may remain negative indefinitely. The illness may last ten days to six weeks or more, with fever bobbing up and down and relapses occurring at any time. Usually it tapers off and may never recur, but repeated relapse is common. If, as often happens, the joints are swollen or excruciatingly painful, rheumatism may be diagnosed.

Fever may be out of all proportion to the severity of the illness, even in patients not confined to bed. Some have a severe illness resembling typhoid and are often so diagnosed. One patient, a nurse, had frequently recurring attacks over a period of seven years. At times her fever reached 107.2 degrees. Finally in a chronic interval she had vaccine treatment. She has been well for the past four years and doing twenty-four hour special duty.

The importance of the chronic phase of brucellosis became increasingly apparent during the study of two young farm hands in 1932. One complained that for four years he had had upper abdominal pain after meals, suggesting peptic ulcer; the other had suffered profuse nose-bleeds, weakness and backache for the past nine years. Both had been examined repeatedly without diagnosis or relief. Both became acutely ill with high fever and typhoid-like states while their cases were being studied, one for eight, the other for twelve weeks. One young man developed what seemed to be perforation of the ulcer and peritonitis, but lacked abdominal rigidity, so he was spared unnecessary operation. The other patient just went on with chills, aches and fever for twelve wearisome, pain-racked weeks. Agglutination tests, tried on a hunch, were strongly positive. These young men contributed much to knowledge of the disease that was to benefit patients who came after them. They recovered from the acute phase of their illness, but then lapsed into the chronic phase with the same symptoms that had

plagued them for years. Both ultimately recovered under vaccine treatment and have been well ever since. Their cases suggested that other patients with various ambulant illnesses might have a chronic brucellosis infection.

Later, a young farmer's wife came under observation because she had lost her baby in the third month of pregnancy and failed to regain her health. There were two subsequent miscarriages with unhealthy afterbirths, and then an inspiration came. Perhaps this woman was going through the same hopeless process as had her husband's and neighbors' cows. In 1917 another physician had described repeated miscarriages in women on farms where cows had recently aborted, but without laboratory proof of the identical nature of the infection. This woman might have brucellosis without fever and perhaps she could be cured. Her blood agglutination test was strongly positive and the germ of brucellosis was cultured from her uterine discharge. Treatment with vaccine and pelvic diathermy restored her to perfect health, but she has waited for five years for a baby that has never come.

Abortion in women is but one of the serious possibilities. How many women are sterile, how many premature and stillborn babies are deprived of their chance for life by this infection cannot yet be estimated.

Coexistence with other diseases may bring serious results. A farmer with slight tubercular infection also had brucellosis. He was not very ill and early x-rays showed no lung involvement. Attacks and remissions alternated, and despite the best of specialized care within a year he was dead. Tubercle bacilli had run their most destructive course, aided and abetted by the undermining influence of brucellosis.

The germ of brucellosis has been shown to cause infection in practically every tissue in the body. It may be the infecting organism in pyelitis, arthritis, meningitis, and even in mastoiditis; it may complicate convalescence from measles or pneumonia to the confusion of the doctor and detriment of the patient.

Happier outcomes may now become possible. Good results have been reported from vaccine treatment, though not in all instances. A woman of middle age, surrounded all her life by the utmost comfort and protection, became ill near one of America's great medical centers. An abrupt, night attack of convulsions, fever and coma resulted only in a diagnosis of colitis. Three months later a

second similar episode was nearly fatal. She rallied and sought the cause from the country's leading doctors. She continued to be weak, pale, anemic and to have distressing abdominal symptoms, but no further diagnosis was made. Twenty-eight apparently sound teeth were found abscessed and removed, but recovery did not follow. Returning to her summer home, resigned to death, she was for the first time given the diagnostic tests for brucellosis. Vaccine brought improvement, and when her gallbladder was shown, under x-ray, to be infected, short wave diathermy was added. Recovery followed although there are still occasional mild recurrences of anemia, fatigue and distention, which yield to resumption of vaccine. The germ is probably still with her, but her resistance has the upper hand.

In the chronic form, the one symptom common to all patients is fatigue. Other signs and symptoms of this strange disease may occur alone or in any combination. A composite case history may serve to illustrate the chronic illness. The patient is most likely to be an adult resident of a rural community, where raw milk has been consumed throughout his life. He may be a farmer or a farm laborer engaged in milking and general care of cows, a butcher or slaughter house employee, a veterinarian or laboratory worker. Not infrequently the patient is a city dweller and has never had raw milk except during summer months spent in the country. He may not recall ever having had raw milk or cream or having come in contact with cattle except for a single instance. Perhaps a soda fountain drink in some small community in the course of a motor trip may have been the only source of exposure, or cream in coffee at a resort hotel.

His reason for consulting a physician is that he does not feel well, that he has been losing weight and is tired for a part or all of each day. Backache, pain and lameness in joints and muscles have appeared and disappeared. His appetite is poor. Headache and mental confusion have worried and depressed him. Glasses have been fitted with no improvement. Skin eruptions, of several confusing types, have appeared at intervals, once closely resembling multiple patches of erysipelas. He has had cystitis and

has been told that there was pus in his urine at times and none at others. He has been constipated and has had gas and indigestion. Neuritis of various parts of the body has led to re-investigation of teeth and removal of one or more found to be infected or dead. Nose-bleeds have been an irregularly occurring source of annoyance. He has been examined at one or more of the leading clinics and has been assured that there is nothing seriously wrong, that he needs a change and rest. He has tried these methods, as well as tonics, ultraviolet light, vitamins and many other things, with little or no effect. He is discouraged by his alternations of apparent improvement and relapse; his hopes have been raised and dashed repeatedly. Diseased tonsils have been removed, with no noticeable effect. He is worried about his lungs because he has heard that his tendency to tire, lose weight and sweat may be caused by tuberculosis or even by cancer. Low-grade afternoon temperature and moderate anemia have added to this worry, although he has no fever at times (if mouth temperature is taken for less than 5 minutes, a low-grade fever will be missed). His chest has been x-rayed, with no definite findings.

In the background there may be a story of unexplained illness several years before with fever which was called influenza or paratyphoid or tuberculosis. Both he and his doctors have dismissed it as an unrelated thing of the past. Or the present condition may have followed an actual influenza or pneumonia, his failure to convalesce normally being the only indication that a latent brucellosis had flared up following the other illness. Or there may have been no history of any acute illness preceding the complaints which brought him to a physician, but just a story of the gradual onset of symptoms which were weakening him physically and mentally.

The doctor who examined him is surprised that there can be so many complaints in a patient who is only slightly anemic and with no other physical findings. Small wonder, then, that brucellosis is so often wrongly diagnosed as neurasthenia, for it follows a textbook picture exactly.

Doctors do not depend on a single test to diagnose or rule out tuber-

culosis. Multiple sputum tests, repeated x-rays, blood and skin tests, together with temperature records and careful physical examination must all be used. Similarly, not one but a combination of four laboratory procedures may be necessary in patients suspected of brucellosis. The cooperation of the patient in the often long drawn out study of the symptoms and history necessary to rule out all other disease is an essential.

The agglutination test, commonly considered sufficient alone for diagnosis, is used to discover what proportion of defensive substance called agglutinins the blood has produced to defend the body against this particular germ. Each of several germs produces its own specific agglutinins in the blood. If that germ were not present, the agglutinins would not be there either. Agglutinins are easy to find, but culturing the germ of undulant fever from blood, body fluid or organs, while a sure test when positive, is a long drawn out and technically complicated process, done only when essential. If positive, the agglutination test proves the presence of infection against which the body is struggling, but agglutinins may never appear in some cases of brucellosis, even after weeks of illness.

The skin test is made, like the tuberculin test for tuberculosis, by injecting a small quantity of vaccine between the layers of the skin on the forearm. Reaction proves that the body is sensitive to the protein of that particular germ, that it has at some time been infected, although the patient may have since recovered. A positive reaction may produce within a week anything from a small red lump to a sore which develops a scab, though strength of reaction does not necessarily indicate degree of infection.

The fourth or opsonocytaphagic test gets its rather impressive name from the tendency of certain white corpuscles, stimulated by another blood by-product called opsonins to phagocyte or surround and digest the live germs. A small amount of fresh blood combined with germs from a live culture under a microscope shows how well they are doing their job. White cells stuffed with germs show that the body is well able to defend itself, even when a positive skin test shows that it has been infected. White cells

with languid appetites are poor protectors and indicate a low opsonic index. The complexities of this test are almost too much even for the experts, for it is a perfect example of the fact that the practice of medicine is no foolproof affair, but a matter of continuously balancing theory, observation and deductive reasoning.

Mortality in acute cases was formerly about 2 per cent, but this has been greatly lowered by modern methods. Bed rest, nursing care and the use of one of the newly discovered "miracle drugs," such as sulfanilamide, have been effective in stopping an acute attack or accomplishing cure in an impressive number of cases. Modified vaccines,

blood transfusions, serums and artificial fever are also used with success. In the chronic phase most authorities agree that vaccine treatment is best, although fever therapy may also be of great value.

Until the medical profession and the public are aware of the seriousness of this situation, preventive measures will continue to be inadequate. One simple precaution which every one can observe is to be sure that all milk and milk products he uses are pasteurized. No vague assurance that the herd has been tested should be enough. The test may have been for tuberculosis, not for contagious abortion. Herds free of infection for years may suddenly develop infection.

The label on the bottle from a reliable dairy stating that the milk is pasteurized is the only safe guarantee. It has been conclusively shown that only a small percentage of vitamins are destroyed by pasteurization and that digestibility, mineral content and caloric value are unimpaired.

The following quotation from Public Health Reports, United States Public Health Service, adequately and authoritatively sums up the case for pasteurization: "If all milk were efficiently pasteurized or boiled before being consumed, there would be no brucellosis except in those occupational groups whose work brings them in contact with infected animals or infected carcasses."

BRUCELLA ABORTUS IN MILK AND ITS
RELATION TO UNDULANT FEVER
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The specific etiology of the undulant fever which occurs in North America, as well as its source, necessitates a most thorough study. There are 3 possible factors to be considered--Br. melitensis, Br. abortus of porcine origin, and Br. abortus of bovine origin.

Br. melitensis, the infective agent of true Malta fever, should be considered first as a possible cause, since cases of this disease have been described as occurring in the southern United States. There is positive evidence that goats in the extreme South are infected with Br. melitensis. Craig reported the first case of Malta fever in the United States in 1905. Later Gentry and Forenbaugh and Yount and Looney reported similar cases. Very recently Watkins and Lake reviewed the literature on Malta fever in this country and have reported additional cases. The danger to man and to the dairy industry from the presence of this infection must not be underestimated by public health officials and sanitary live stock officers. The time to control melitensis infection is before it becomes widespread.

Several investigators believe that our cattle may now be infected from this source and that because of the great traffic in the dairy industry it has spread to other parts of the country. The isolation of Br. melitensis from one bovine fetus collected at Gambrills, Md., by the U. S. Bureau of Animal Industry, has been reported by Evans. There is a possibility that certain individuals may have contracted the disease from dairy products produced in the South and distributed to other parts of the United States. Another suggested source of Br. melitensis in this country is its introduction from Europe with dairy products, principally cheese made from milk of sheep and goats where Malta fever exists.

A few observers report that Br. abortus of porcine origin is the cause of undulant fever in America. We designate as of porcine origin a culture of Br. abortus isolated directly from swine. It is difficult to determine whether abortion disease spreads from cattle to swine or from swine to cattle.

However, it may be stated that infectious abortion in cattle was described many years before it was reported in swine. In general it may be stated that porcine strains of *Br. abortus* are more virulent for guinea pigs than are bovine strains. Yet there is considerable evidence indicating that this hypothesis cannot always be accepted. A study of the virulence of cultures of *Br. abortus* isolated from various sources is always difficult because of the rapid change in virulence under artificial cultivation which may be due to the microaerophilic tendencies of the organism. There is no doubt that animal passage from one species to another or even among animals of the same species effects a gradual change of virulence.

Many of the cultures of *Br. abortus* isolated from cases of undulant fever in man are as infectious for guinea pigs as are certain porcine types. McAlpino and Slanetz have reported that carbon dioxide causes a partial inhibition of the growth of porcine and human strains while the growth of the bovine strains is stimulated by it. They state further that the human and porcine cultures utilize from 4 per cent to 18 per cent glucose, increase the non-protein nitrogen and produce very little free ammonia, while those of bovine origin utilize practically no glucose, decrease slightly the non-protein nitrogen and produce large amounts of free ammonia. Because of such similarities between the human and swine cultures of *Br. abortus*, the infection in man has been ascribed to the latter type. However, we have recently recovered from milk a culture of *abortus* that utilizes 12 per cent glucose.

In a few instances, cases of undulant fever have occurred in meat inspectors or butchers who have been in contact with swine, but possible contact with carcasses of cows that have aborted or milk that might have contained the infection has not always been considered. Without doubt a small percentage of the cases occurring in the United States may be traced to the porcine strain as a result of wound infection.

Some of the biological characters of the bovine type of *Br. abortus* have been discussed above in comparing it with that of porcine origin. Serologically the 2 species cannot be differentiated. The so-called typical bovine type, according to Smith, will not produce abscess formation of the lymph nodes and spleens of guinea pigs whereas the majority of porcine strains will produce such lesions. Olafson, however, has observed that certain strains of *abortus* isolated from cattle will produce abscess formation of the lymph nodes, spleens and livers of guinea pigs. The incidence of abortion disease in cattle and the virulence of the causative agent are extremely variable in different herds. *Br. abortus* is discharged from the uterus and mammary gland, and at the time of abortion the placenta and uterine exudate are teeming with the organisms. The infection in the uterus usually disappears within a few weeks after the expulsion of the fetus. A large percentage of cattle that abort show this infection in the colostrum, but it may disappear soon after the normal milk is secreted. However, 20 per cent to 80 per cent of this group continue to harbor the infection in their mammary glands.

throughout their lifetime and eliminate it with the milk. It often happens that many herds that do not show clinical evidence of the disease are infected with *Br. abortus*. The herdsman will state that the animals are free from abortion but frequently several carriers can be detected by the blood test.

Br. abortus was first reported in milk by Smith and Fabyan and Schroeder and Cotton in 1912. Since those observations extensive studies have been made on the prevalence of this organism in milk. One of the most important contributions was made in 1918 by Evans while studying this problem. She demonstrated the very close biological relationship that exists between *Br. molitensis* and *Br. abortus*. As a rule, only a comparatively few (20-500) *abortus* organisms can be cultivated from 1 c.c. of milk. It has been observed that after milk has stood or has been centrifuged the greatest numbers of *Br. abortus* are found in the cream content of the sample, having been carried up with the fat globules. Carpenter and Boak have found *Br. Abortus* to remain viable in cream from 8 to 10 days at ordinary refrigerator temperatures (8 degrees-10 degrees C.) and to live in butter 142 days under similar conditions when the butter had been made from unpasteurized sweet cream.

In 1925 the senior author reported 2 cases of undulant fever in Cornell University students at Ithaca, for which there could be found no possible source of infection except the raw milk that the patients had drunk. A careful investigation was made of abortion disease in the herd supplying this milk. The mixed milk was examined for 30 days, and daily was found to be infected. A blood test showed that 10 of 16 animals comprising the herd were positive and the injection of the milk from these 10 into guinea pigs showed 9 to be discharging *Br. abortus*. The guinea pigs became emaciated and showed lesions described as typical of those produced by *Br. abortus* of porcine origin. An epidemiological study of undiagnosed fevers in this community revealed that several cases of a typhoid-like disease had occurred on this same milk route but no definite diagnoses had been made previous to our examinations. The milk from a second small herd in this vicinity, consisting of 3 cows, was carefully studied because it was supplied to a university instructor who has been incapacitated with undulant fever for approximately 18 months. The mixed milk showed the presence of *abortus* infection for 7 of the 13 days upon which examinations were made. A history of the herd revealed that 1 of the animals had aborted 2 years in succession and her milk was heavily infected. The other 2 cows were normal.

We have thoroughly investigated 52 other cases of undulant fever that have been diagnosed in our laboratories, have studied the histories and sources of infection, and have examined the milk consumed by them in all but 6 instances. Seventeen cases have occurred in Ithaca, N. Y., since the work on this disease was undertaken. Eleven of these were university students; 3, housewives; 1, a high school student; 2, university instructors, 1 of whom was a bacteriologist. Because of the proximity of these cases to one of our laboratories, we have had an excellent opportunity to make a thorough study of the

disease in this community as well as of the prevalence of Br. abortus in the milk supply. Carpentor and Baker have reported the results of the examinations of 50 herds of cattle that were supplying most of the raw milk in this area. They found that the milk from 9, or 18 per cent, contained Br. abortus.

It is very interesting to note that, with the exception of the bacteriologist, the other patients were persistent drinkers of raw milk or cream. The bacteriologist who had the disease had been working with cultures of Br. abortus of bovine origin at this time and had never had in his laboratory, to his knowledge, any porcine strains of Br. abortus or cultures of Br. melitensis. The histories of the cases at Ithaca, N. Y., showed that none of them had been in contact with swine, cattle or goats and the only manner in which they could have acquired the infection, in so far as we could determine, was from the raw milk which they had drunk.

A study was made of the milk supplied to a case of undulant fever reported by Fisher and Garon of Olean, N. Y. This case was that of a young man living on a farm where 13 cows were kept. Twelve of these animals were positive to the blood test for infectious abortion but only 1 was eliminating Br. abortus in her milk. The milk from from this cow was saved for home use and drunk by this man.

The milk from a farm near Marathon, N. Y., whose owner was suffering from undulant fever, was also examined. The herd consisted of 10 cows. The agglutination test on the blood serum of these animals showed 4 to be definitely infected and a fifth one suspicious. Guinea pigs injected with the milk from these infected cows showed only 1 to be eliminating Br. abortus at the time of examination.

A survey was made of the raw milk supply of Newark, N. Y., where 4 cases of undulant fever had been diagnosed. We had an opportunity to get blood samples from all the cows supplying milk to this village. The milk from every cow whose serum contained abortus agglutinins was examined for Br. abortus by animal inoculation. The data showed that Br. abortus was present in the mixed milk from only 3 of 15 herds. In studying the histories of the 4 cases of undulant fever it was found that the mixed milk from 2 of these 3 infected dairies was being supplied to them. In these 2 herds 94 per cent and 63 per cent of the animals were positive to the blood test for infectious abortion. When examinations were made of the milk from the infected cows in these 2 dairies showing evidence of the disease, 25 per cent and 36 per cent, respectively were discharging Br. abortus.

At Utica, N. Y., 4 cases of undulant fever occurred on one milk route. We examined the blood serum from 37 cows comprising this herd and found 12, or 32.4 per cent, of the animals to be infected. The milk from the cows was examined with negative results but only 1/2 ounce was collected from each animal, which amount we consider insufficient. We believe, however, that could we have had 1/2 or 1 pint samples,

which is the customary amount tested, Br. abortus would have been found. The milk contained a high antibody content and we have observed that in 95 per cent of such samples Br. abortus is present in comparatively large numbers.

Approximately 90 per cent of the milk consumed in Syracuse, N. Y., is pasteurized and therefore there should be very few cases of undulant fever if milk is the source of the infection. We examined the mixed milk from 2 dairies that were distributing raw milk. One herd supplied certified milk while the second sold grade A raw. Br. abortus was recovered from both samples. The total amount of milk from these 2 herds, however, comprised only a very small percentage of the milk sold in this city.

These findings correspond remarkably well with the results obtained on 4,050 routine Wassermann samples collected by the Bureau of Health Laboratories at Syracuse and tested for abortus agglutinins by Carpenter and Chapman. Seven and three-tenths per cent of the samples contained these antibodies. A study of the histories of the patients with a positive serum showed that the majority were living outside the city of Syracuse in smaller towns and villages where there was a raw milk supply.

Dr. King observed a case of undulant fever at the Metropolitan Life Insurance Company's sanatorium at Mt. McGregor, N. Y. This prompted an investigation of abortion disease in the sanatorium herd as well as a routine examination of the serum from all patients and the staff at this institution. The herd consisted at this time of 150 cows. A blood test of this group showed 82, or 54.6 per cent, of the animals to be infected with Br. abortus. The milk from the infected animals was then examined and 24, or 29.2 per cent, of them were found to be eliminating the organism.

A routine test on the serum from the 530 patients and staff showed 69, or 13 per cent, to have abortus agglutinins. Eight of these had shown definite symptoms of undulant fever. Many others had a history of symptoms suggestive of the milder form of the disease. All of the patients had been drinking large amounts of the raw milk and cream from this herd. Because of these findings the infected cows were segregated and the milk from the cows discharging abortus was pasteurized. We then considered the milk supply to be free from living abortus infection. The routine serum examinations on 448 new patients and employees was continued after the milk was supposedly abortus free. The results of these tests have shown only 6 of the 448 to have a few abortus agglutinins. The 6 serums produced only sedimentation of the antigen when the serum was diluted 1:15. At the time we observed these 6 serums we discovered that 1 cow, whose milk had been negative repeatedly, began to discharge Br. abortus after a normal gestation period. Unknowingly her infected milk was mixed with the raw abortus-free milk for approximately 6 weeks before it was detected. The examination of serums from approximately 100 patients for a period of 3 months since the pasteurization of her milk has given negative results.

None of the individuals in the negative group of the first 530 tested has shown abortus agglutinins since the elimination of Br. abortus in the milk. Because 44.9 per cent of the patients at the Metropolitan Life Insurance Company Sanatorium with serum containing abortus agglutinins were diagnosed as tuberculous, it occurred to us that the agglutination of the abortus antigen might be due to agglutinins produced by the tubercle bacillus. Therefore we decided to make further observations on the serum from patients in various tuberculosis sanatoriums where in some the milk supply was pasteurized and in others raw milk containing Br. abortus was used.

Blood was collected from 42 patients at the Saratoga County Sanatorium and examined for abortus agglutinins. Two of these serums showed abortus antibodies. An examination of the blood serum from 12 cows supplying milk to this sanatorium showed that 3, or 25 per cent, were infected with Br. abortus. Guinea pigs injected with the milk from the entire group showed none of the animals to be discharging Br. abortus at the time the examination was made.

Through the cooperation of Dr. George Bigelow, Commissioner of Health of Massachusetts, and with laboratory facilities offered to Dr. King by Dr. Hans Zinsser of the Harvard Medical School, the serums from 690 patients in 3 state sanatoriums in Massachusetts were examined for abortus agglutinins. Not a single serum showed agglutinins for this organism. The milk supply for each of these institutions is carefully pasteurized.

To obtain data on the amount of Br. abortus infection in milk in a comparatively large territory, a survey of the raw milk supply of 3 counties in central New York was made. The territory included 67 towns and villages, 2 cities with an approximate population of 20,000, and 1 city of 200,000. Samples from 122 distributors were collected, which represented approximately 95 per cent of the raw milk sold and consumed in this area.

Guinea pigs were injected with 2 c.c. of the mixed cream and sediment after a 500 c.c. sample had been centrifuged at high speed for 15 minutes. The guinea pigs were autopsied from 25 to 35 days after injection and examined for lesions of abortion disease. The spleens were cultured for evidence of Br. abortus infection. Twenty-five, or 20.4 per cent, of the samples showed the presence of this infection. The milk serum from each sample was examined for abortus agglutinins and 18 of the samples showed these antibodies. The biological characters of the various strains isolated are being studied to determine whether any of the cultures may be Br. molitensis rather than Br. abortus. Their virulence for guinea pigs is being determined as well as their biochemical activities. We have observed a marked difference from the typical bovine strain of Br. abortus in 3 of the cultures recovered, which grow readily on slanted nutrient agar in unsealed tubes.

DISCUSSION

A review of the published case reports of undulant fever in the United States and of our own cases gives a total of 155 which have been diagnosed as definitely due to *Br. abortus*. Fifty-two cases have been reported as Malta fever caused by *Br. melitensis* infection, although in some instances very meager information concerning the bacteriology of the cases is given and in our opinion such a diagnosis is sometimes questionable. The first reported case of undulant fever was that of Koofor in 1924, and the great increase in the number of reported cases during a period of 4 years emphasizes the importance of this disease as a public health problem. A recent epidemiological report from the Health Section of the League of Nations has called attention to the prevalence of the disease in Europe, particularly in those countries where Malta fever does not occur. Undulant fever became a reportable disease in Denmark in 1927. During the first 3 months of 1928, 62 cases of undulant fever were diagnosed in that country. Last year in a discussion on *Br. abortus* infection in man, Prof. Bernard Bang of Copenhagen stated that this was not suspected in Denmark until reports of the disease came from America.

An analysis of the possible sources of the infection of the reported cases gives evidence of the danger of raw milk containing *Br. abortus*. One hundred and nine of the 155 cases have a history of drinking various amounts of raw milk from which, in the majority of instances, *Br. abortus* was isolated. In 35 cases no information was obtained as to whether or not the patients had been drinking raw milk. Only 7 of the cases of undulant fever had been directly in contact with swine or had been on farms where abortion disease in swine had occurred. Four laboratory infections with *Br. abortus* have been reported.

It would seem that if the porcine strain of *Br. abortus* in man is largely responsible for undulant fever in the United States, there would be more evidence of a closer relationship between this disease and abortion in swine. Of course it may be argued that the infection in swine has been transmitted to cattle. Some experiments have been reported indicating that the bovine type is not pathogenic for swine and that the porcine type is not pathogenic for cattle. However, by the injection of a limited number of cattle with porcine cultures, we have demonstrated that porcine strains readily infect the cattle and become established in the mammary gland. In New York State the incidence of undulant fever is approximately the same as in other sections of the United States but porcine abortion is comparatively rare. In so far as we can ascertain, only 1 culture of *Br. abortus* has been isolated from a porcine fetus during the last 10 years. Inasmuch as the data show that about 20 per cent of the samples of raw milk from a comparatively large territory are infected with Bang's bacillus, it cannot be supposed that all of these cultures have the same virulence.

Our study of the disease shows clearly that *Br. abortus* is only slightly pathogenic for man and it must be that only the most virulent strains in milk are of danger to him. It

may be that an accumulative infection in the tonsils, lymph nodes or other tissues is necessary, and at some time when the individual is fatigued, convalescing or suffering from some other disease, *Br. abortus* may invade the blood stream, causing the disease or setting up an intercurrent infection. We know of only 2 cases of undulant fever in children under 6 years of age, the majority of cases occurring between the years 15 to 45. The fact that children are not so susceptible as adults cannot be explained at this time because children consistently drink more milk than adults. However, when calves are fed infected milk we have found that as a rule the organism will not remain permanently in their tissues after the source of infection has been removed.

Fleischner and Moyer have shown that agglutinins are developed in the blood serum of monkeys following the intravenous injection of cultures of *Br. abortus* isolated from milk and that later the organism may be recovered from the spleen, lymph nodes, liver and kidneys. This was also accomplished by feeding monkeys bread and carrots upon which bovine cultures of *Br. abortus* had been spread. When such experimental animals were fed the milk from a goat infected with *Br. abortus*, the same results were obtained. Unpublished work by King, on feeding monkeys bovine cultures isolated from milk, shows the invasiveness of the organism from the gastrointestinal tract. That a marked difference exists among such cultures is indicated by the fact that 2 of 13 failed to produce any evidence of infection. Such data lead us to believe that the organism can invade a normal mucous membrane and gain entrance to the circulating blood. Since approximately 7 per cent of the routine Wassermann samples showed *abortus* agglutinins, we believe that this suggests a greater incidence of the invasion of *Br. abortus* in man than case reports at present indicate. The presence of specific agglutinins is evidently a result of an active infection instead of a passive absorption of such antibodies from drinking milk containing them. In feeding experiments that have been conducted with adults drinking pasteurized milk with a serum titer of from 1:400 to 1:1,200 we have failed to find agglutinins in their blood serum following the consumption of a liter of such milk daily, for a period of 10 days. Undoubtedly some agglutinins from the milk serum are absorbed, but because of the great dilution factor due to the amount of blood in the tissues they cannot be demonstrated. We rarely find the mixed milk from 1 herd or from several to have a serum titer greater than 1:45. We have observed, however, that when milk from an individual cow has a serum titer greater than 1:45, *Br. abortus* can usually be isolated from it.

Studies of the thermal death point of *Br. abortus* in milk show that our present methods of pasteurization are effective. In no instance have cases of undulant fever developed from a pasteurized milk supply, with the exception of 2 cases that clearly seemed to be due to a wound infection resulting from contact with swine and a third case of a veterinarian who had manually removed the placenta from a cow that had aborted and died later from metritis.

From the data submitted we believe that milk is the logical source of Br. abortus infection in man. Whether the origin of the strains that are pathogenic for man are from cattle or swine we are unable to state at this time. There seems to be no reason why cattle cannot become infected with the swine strains if the two species are in close contact with each others. However, in New York State we have failed to observe porcine abortion though our observations and inquiries have been extensive.

CONCLUSIONS

An examination for Br. abortus has been made of the milk supplied to several communities where cases of undulant fever have occurred, as well as of that drunk by individuals suffering from the disease. The results have shown that the milk contained comparatively large numbers of the organisms and was produced by herds extensively infected with Br. abortus.

An examination of the serum from 530 individuals known to have drunk raw milk containing living Br. abortus from a single herd in which 54.6 per cent of the animals were infected, showed 13 per cent to contain agglutinins specific for this organism. Eight from this group were showing definite symptoms of undulant fever at the time the examinations were made, while others gave a history of symptoms suggestive of the disease. The serums from a group of 690 individuals known to have drunk raw milk free from abortus infection or milk carefully pasteurized have shown no agglutinins, nor have any cases of undulant fever occurred in the group.

A survey of the raw milk supplied to 67 towns, 2 small cities and 1 city of 200,000 showed the presence of Br. abortus in 20.4 per cent of the samples examined.

A review of 155 case reports of undulant fever due to Br. abortus showed that 109, or 70.3 per cent, had been drinking raw milk which in the majority of cases was proved to be infected with Br. abortus. No information concerning the source of the disease could be obtained in 35, or 22.6 per cent, of the cases; 7, or 4.5 per cent, had either been directly in contact with swine or had lived on farms where porcine abortions had occurred; 4, or 2.6 per cent, were considered to be laboratory infection.

Evidence has been submitted that suggests raw milk, unpasteurized cream, or butter made from unpasteurized sweet cream, to be the source of undulant fever in the United States.

BRUCELLOSIS IN AND AROUND VANCOUVER

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The veterinarians and dairy farmers of the lower mainland of British Columbia concur in acknowledging that bovine contagious abortion is very prevalent throughout the Fraser River valley, the sole source of the fluid milk supply for Vancouver and the neighbouring municipalities. Unfortunately no authoritative surveys of the incidence of the disease among local herds have been recorded, nor is it possible to state whether the situation is improving or otherwise. But the stringent regulations enforced at the international border, whereby Bang reactors (or cattle showing blood serum agglutinins against a *Brucella* suspension) are forbidden entry into the western States, must tend to an accumulation of infected cattle on this side of the border.

In view of this situation, and of the then apparently increasing percentage of raw milk distributed in Vancouver, a survey was begun two years ago in this laboratory of the *Brucella* agglutinin titre of the whey in raw milk samples brought in by sanitary inspectors for bacterial plate counts. Moreover, for the past six years, all blood specimens sent to the Provincial Board of Health Laboratories in Vancouver for Widal tests have been examined for the presence of *Brucella* agglutinins. In this communication the results of these two surveys will be recorded and their significance discussed and illustrated by reference to the main clinical, aetiological, and bacteriological features of a group of 15 recent cases of severe undulant fever occurring in or near Vancouver.

Jordan (1), Johns, Campbell, and Tonnant (2), Hall and Loarmouth (3), and others have reported their laboratory and clinical findings among relatively small groups of institutionalized patients known to have been exposed to a *Brucella*-infected milk supply. But we have found no record of any investigation in Canada comparable, in respect of the numbers and types of specimens involved, to that which forms the subject of this report.

BRUCELLA AGGLUTININS IN WHEY FROM RAW-MILK SAMPLES

In partial fulfilment of the regulations governing the bacterial standards of raw milk purveyed within the city, the Provincial Laboratories perform the coliaerogenes test, and total colony counts, on samples secured by sanitary inspectors at least once monthly from each of the 55 licensed raw-milk distributors in Vancouver. A portion of every sample thus received has been treated with rennet according to Torrey's method (after the cream layer formed on overnight standing has been pipetted off) and the *Brucella* agglutinin titre of the whey determined as follows:

The antigen used was an 0.5 per cent. phenolized saline suspension (standardized to the equivalent of MacFarland No. 2) of four strains of *Br. abortus*, one strain of which came several years ago from the Ontario Department of Health Laboratories, while the other three were obtained from Dr. Huddleson about two years ago. All four strains had become adapted to growth in ordinary atmospheres on Huddleson's liver infusion agar, but conformed in all other respects, including their susceptibility to various aniline dyes, to the generally accepted criteria for *Br. abortus*. Suspensions prepared therefrom showed no tendency to non-specific agglutination. A semi-dilution series of 0.5 cc. volumes of whey, extending over a range from 1:12.5 to 1:100, was distributed into agglutination tubes. To each tube 0.5 cc. of antigen was added, thus giving a range from 1:25 to 1:200 of whey in the final mixtures. Tubes were incubated at 37 degrees C. for 48 hours, and read after standing an additional 24 hours at room temperature. No inhibitory zones were noted in this survey of whey agglutinins. Readings were classified as follows:

- i. No agglutination, or only slight,
in 1:25..... Negative
- ii. Partial agglutination in 1:25, with
slight agglutination up to 1:50. Doubtful
- iii. Complete agglutination in 1:25 only +
- iv. Complete agglutination up to 1:50.. ++
- v. Complete agglutination up to 1:100. +++
- vi. Complete agglutination to 1:200 or
over..... +++++

From March, 1936, to March, 1938, inclusive, a total of 1,296 separate raw milk samples was received and examined for *Brucella* agglutinins by the method described. Of this total, 704 samples (54.3 per cent.) showed complete agglutination in one or more tubes of the range adopted; while a further 168 (13 per cent.) gave a doubtful reading. Thus less than 33 per cent. of samples were completely negative for *Brucella* agglutinins. Submitting results on the 704 positive samples to further analysis, 186 (26.4 per cent. of the positive group) gave a + readings; 275 (39.0 per cent.) gave ++; 173 (24.6 per cent.) gave +++; and 70 (10 per cent.) gave ++++ readings.

When the results are analyzed according to dairies, they assume a yet more serious potential significance. In table I the raw milk dairies of Vancouver have been classified in three categories according to the types of result given by their respective samples. Category 1 includes 9 dairies, among whose 213 samples no negative specimen was found. Category 3, on the other hand, covering dairies which yielded no positive specimens, includes only 60 samples from 3 dairies. Category 2, into which fell roughly four-fifths of the dairies and their specimens, shows a great preponderance of positive and doubtful results.

We would emphasize that the foregoing findings relate to bottled milk samples, taken as sold, and therefore containing the pooled milk of several cows. In a few instances we have had the opportunity of determining the effect of pooling upon the agglutinin titre of the composite sample.

For example, among 21 samples of bottled milk received at monthly intervals from dairy A, Vancouver, the result was never negative; was doubtful on three occasions; + on six occasions; ++ on eleven occasions; and +++ once. On no occasion was a ++++ reading (complete agglutination in 1:200 or over) obtained. However, when an opportunity came to examine milk samples from 29 individual cows in this dairy's herd, the findings were as follows: nineteen samples gave a negative result; four samples gave a + result; one gave a ++; one gave a +++; and four samples gave a ++++ result. Among this last group of four, the limiting titre proved to be 1:200 in one sample, 1:400 in another, and 1:800 in the two remaining samples. From each of the two latter samples, *Br. abortus* was isolated on Huddleson's liver-infusion gentian-violet agar (4).

TABLE I

BRUCELLA AGGLUTININS IN RAW-MILK SAMPLES FROM DAIRIES DISTRIBUTING IN VANCOUVER (MARCH 1936-MARCH 1937)

Category	No. of Dairies	Total No. of Tests	Positive	Doubtful	Negative
1.	9	213	203	10	0
2.	43	1,023	501	157	365
3.	3	60	0	1	59
Totals	55	1,296	704	168	424

Neg. = no agglutination, or only slight, in 1:25 whey

+ = complete agglutination in 1:25.

++ = complete agglutination in 1:50.

D. = partial agglutination in 1:25, with slight in 1:50.

+++ = complete agglutination in 1:100.

++++ = complete agglutination in 1:200.

The agglutination reactions given by the monthly pooled samples from each dairy are listed on charts in the laboratory. Not infrequently, these charts have shown a sudden marked change in the whey agglutinin titre of a given herd. Such changes, as is evident from the following examples, may be of considerable public health significance.

TABLE II

INFLUENCE OF ONE INFECTED COW UPON AGGLUTINATION REACTIONS OF POOLED MILK SAMPLES

Dates of tests on pooled samples	Total No. of monthly tests	++++	+++	++	+	D.	Neg.	Comments
Mar. 1936- Jan. 1937	11	3	3	2	0	0	0
Feb. 1937- Aug. 1937	7	0	0	0	0	2	5	Cow "X" removed from herd early in February
Sept. 1937- Nov. 1937	3	0	1	2	0	0	0	Cow "X" returned to herd early in September

Neg. = no agglutination, or only slight, in 1:25 whey

+ = complete agglutination in 1:25.

++ = complete agglutination in 1:50.

D. = partial agglutination in 1:25, with slight in 1:50.

+++ = complete agglutination in 1:100.

++++ = complete agglutination in 1:200.

For example, dairy B, Vancouver, over the five-months' period April-August, 1936, yielded three negative and two doubtful samples of pooled milk. The laboratory findings then suddenly changed. From September, 1936-November, 1937, no negative or doubtful samples were received; but of a total of 14 monthly pooled samples, six gave a + result; six gave a ++; and two gave a +++ result. Three months after our laboratory findings had so markedly changed, patient no. 3 in our series, who received his milk supply from this dairy, fell ill and took to bed. Shortly afterwards we readily isolated Br. abortus, not only by blood culture from this patient, but also from a composite milk sample from this dairy. Incidentally the particular sample of milk from which Br. abortus was grown, showed only a ++ agglutination reaction (i.e. complete agglutination up to 1:50 whey dilution).

Dairy C, Vancouver, also provides an instructive example. The herd contained 9 cows. The agglutinin reactions of monthly pooled milk samples are shown in table II. In February, cow X, with a history of previous abortion, being about to calve again, was segregated. In the ensuing seven months, during which the milk from cow X was not included in the pooled milk, herd samples (which had previously been always positive) gave either negative or doubtful reactions. Meanwhile, Br. abortus was isolated on four separate monthly occasions from the milk of cow X. The agglutination titre of its colostrum was as high as 1:25,600, and Br. abortus was grown therefrom; but the titre of its milk subsequently ranged between 1:800 and 1:1,600 over a period of eight months, irrespective of whether or not Br. abortus was isolated. After only one or two successive monthly milk samples had had proved negative on culture, cow X was returned to the herd. The inclusion of its milk in the next three pooled samples is clearly shown by their agglutination reactions.

On one occasion, undulant fever in a dairy farmer's wife (patient no. 4 in our series) afforded an opportunity of performing parallel agglutination tests upon the blood serum and whey of individual cows in the herd. The results are shown in table III. With only one exception, the blood serum titres proved higher than those of the corresponding whey specimens. Despite the agglutination titre of the whey being only 1:50, Br. abortus was isolated from the milk of cow no. 8.

TABLE III
COMPARISON OF AGGLUTININ TITRES IN BLOOD SERUM AND IN WHEY FROM
INDIVIDUAL COWS OF AN INFECTED HERD
(Dairy C., Abbotsford)

Cow No.	Blood serum: agglutination complete to	Whey: agglutination complete to
4	1:100	Negative
5	1:1600	Specimen unsatisfactory
6	1:5000	1:200
8	1:1200	1:50*
9	1:50	Negative
10	1:400	1:500
11	1:200	1:200
12	1:25	Negative
13	1:200	Negative
17	1:400	1:200
1-3, 7, 14-16	Negative	Negative

Negative--no agglutination detectable in 1:25 dilution.

*N.B.--Br. abortus isolated from milk of cow no. 8.

BRUCELLA AGGLUTININS IN HUMAN BLOOD SERUM SAMPLES

Blood serum samples sent to these laboratories for Widal tests during the past six years from some 5,420 persons have been routinely tested for Brucella agglutinins. The results obtained with one group of 5,068 specimens, sent in by physicians of Vancouver and adjacent municipalities, are set forth in table IV.

In connection with these results, a minor complication arises from the fact that lack of facilities prevented, until August, 1936, replacement of the rapid microscopic method of performing the Brucella agglutination test by the more satisfactory macroscopic method similar to that already described for the whey test. Complete macroscopic agglutination in a serum dilution of 1:20 or higher was thereafter termed a positive result, whereas previously definite microscopic agglutination in a serum dilution of 1:120 or higher had been reported as positive. A series of parallel titrations on a number of specimens verified the general validity of adopting a 6:1 ratio of sensitivity as between the two methods; but the microscopic method proved rather inconsistent, and often gave titres more nearly approximating those obtained on the same specimen by the macroscopic method.

TABLE IV
BRUCELLA AGGLUTININS IN HUMAN BLOOD SERA FROM RESIDENTS OF VANCOUVER
AND ADJACENT DISTRICTS

Year	Total nos. of Specimens tested	Nos. positive for Brucella agglutinins	Per cent. positive for Brucella agglutinins
1932	376	10	2.7
1933	427	11	2.5
1934	428	18	4.2
1935	725	66	9.1
1936	1,209	41	3.4
1937	1,538	68	4.4
1938 (3mo.)	365	14	3.8
Total	5,068	228	4.5

To Aug. 1936, positive = definite microscopic agglutination to 1:120 dilution of serum or higher.

Subsequently, positive = complete macroscopic agglutination to 1:20 dilution of serum or higher.

Over the whole six-year period, the incidence of positive samples among a total of over 5,000 sera tested, was 4.5 per cent. Very few of these specimens were sent in under a provisional diagnosis of brucellosis, and we have no information regarding the clinical signs and symptoms from which the majority of the 228 persons with positive sera may have been suffering. However, the further analysis of their limiting agglutination titres, made in table V, suggests that about 42 of this group probably had an acute attack of brucellosis at the time; while at least 64 must have had a fairly recent attack of brucellosis.

TABLE V
LIMITING BRUCELLA AGGLUTININ TITRES OF 228 POSITIVE HUMAN SERA

Titre limits for complete macroscopic agglutinations		No. of specimens positive
1:20	or higher	228
1:40	" "	147
1:80	" "	101
1:200	" "	64
1:500	" "	48
1:1,000	" "	42
1:2,000	" "	21
1:5,000	" "	7
1:10,000	" "	3
1:20,000	" "	1

Note: Where a microscopic test was actually done on the specimen, the titre then shown by the serum has been divided by six, to ensure a conservative macroscopic equivalent being assigned to it (cf. text).

Of the group of 5,068 specimens, over 90 per cent. are known to have come from patients living in or immediately adjacent to Vancouver. The results shown by this group may be contrasted with those given by a group of 352 specimens received from employees of a logging camp and from residents of a paper-pulp-company town, living remote from Vancouver and its milk supply. In this group, only 2 specimens, or 0.57

per cent., were positive, and gave complete agglutination in serum dilutions no higher than 1:40 and 1:80 respectively. Although there is admittedly a marked difference in the size of the two groups of sera under consideration, the smaller group includes a sufficiently large number for the contrast in findings to be deemed statistically significant. The incidence of *Brucella* agglutinins in the sera of the Vancouver group is roughly eight-fold that in the other group.

ACUTE BRUCELLOSIS ATTRIBUTABLE TO RAW-MILK CONSUMPTION

No attempt was made to trace the clinical history of every patient with a positive serum in the above groups, but in recent months we have telephoned to all city physicians sending in specimens which gave complete agglutination in serum dilutions of 1:1,000 or higher. With the ready co-operation of the physicians concerned, fifteen cases of undoubted acute brucellosis have thus been diagnosed on both laboratory and clinical grounds. In every case, the evidence has pointed to raw-milk consumption as the primary aetiological factor.

CLINICAL FINDINGS

The characteristic symptomatology of acute brucellosis has been too well recorded in the literature to need further elaboration. But a striking uniformity of clinical signs and symptoms was shown by our group, despite the age range being from 14 to 66 years. Eleven patients were male and four female. General weakness and depression, with fever lasting from several days to a few weeks at a level of 103 degrees F. or even higher, and associated with drenching night sweats, muscle and joint pains, and headache, were typical of the onset. Six patients in the group had an acute sore throat in the early stages of the disease, and in this connection it is of interest to note that Poilma and Pickens (5), and Carpenter and Boak (6) reported the isolation of *Br. abortus* from tonsils. A leucopenia (total W.B.C. 4,000 to 6,000 per cmm.), with a relative lymphocytosis (38 to 63 per cent.), was present throughout the acute phase of the disease in every patient tested. Splenic enlargement was not a conspicuous feature, but a big loss in weight was characteristic. Three of the now convalescent patients show respectively the following neurological or psychological sequelae: partial deafness and ataxia; intermittent paralysis of an arm with migraine-like headaches; and marked emotional depression. In almost every case the original diagnosis was influenza. In four of the patients, this diagnosis was subsequently changed to rheumatic fever, septic arthritis, paratyphoid fever and appendicitis, respectively. When the fever persisted, or returned after a brief remission, the diagnosis for the rest of the group was changed to pyrexia of unknown origin. In only one instance had the doctor either enquired into the milk supply, or made a provisional diagnosis of undulant fever, prior to our laboratory reports on the *Brucella* agglutinin titre of the patient's serum.

TABLE VI

LABORATORY FINDINGS IN 15 HUMAN CASES OF ACUTE BRUCELLOSIS

Patient No.	Age	Sex	Agglutination Titre of first specimen received	Results of Blood Culture	Comments
1	17	M	1:10,000	4 positive specimens at 2, 5, 8 and 12 weeks	Drank raw milk for 9 months prior to onset. Fair recovery with neurological complications after six months' illness.
2	38	F	1:2500	2 positive specimens at 1 and 3 weeks	Drank raw milk for seven months prior to onset. Good recovery after 7 months' illness.
3	55	M	1:500	4 positive specimens: concurrently and at 4, 9 and 18 weeks	Br. abortus isolated from his milk supply. Unable to work for 1 year. Poor recovery. Ataxic and deaf.
4	40	F	1:2000	One negative specimen at 1 week	Dairy farmer's wife. Br. abortus isolated from her milk supply. Incapacitated for several weeks.
5	17	M	1:1200	6 positive specimens: concurrently and at 1, 3, 7, 26 and 41 weeks	Very serious case with several relapses. Temperature continuously over 104 degrees for 10 days at one period. Now getting better after 1 year's illness. Supplied with "preferred raw" milk by a dairy of high repute.
6	28	M	1:4800	4 negative specimens at 1, 2, 7 and 38 weeks	Moderately ill and unable to work for several months.
7	59	M	1:2000	One positive specimen at 4 days	Not yet recovered. Ill 13 weeks to date. Keeps own cows.
8	55	F	1:2000	2 negative specimens: concurrently and at 6 weeks	Not yet recovered. Ill 6 weeks to date. Supplied with raw milk from patient No. 7's cows.
9	27	M	1:2000	1 negative specimen at 7 weeks	Not yet recovered but now ambulatory. Ill 12 weeks.
10	14	F	1:1600	No specimen obtained	Had relapse after 1 year interval. At first attack had generalized rash and acute sore throat.
11	44	M	1:3200	4 negative specimens at 4 days	Keeps own cows.
12	30	M	1:2560	2 positive specimens at 5 days and 1 week	Policeman. Suffered with sweats on night duty. Finally had to report sick.
13	66	M	1:6400	1 positive specimen at 1 week	Supplied with "preferred raw" milk by same dairy as No. 5. Ill 10 weeks.
14	45	M	1:2560	1 positive specimen at 4 weeks	Br. abortus isolated twice from his milk supply. (Bottles purchased over shop counter.)
15	20	M	1:3200	2 positive specimens: concurrently and at 2 weeks	Ill several weeks. At present free from symptoms.

AETIOLOGY

Every one of the foregoing patients had regularly consumed raw milk prior to the onset of illness. Except for three persons, who contracted their infection outside this city, all in the group obtained milk from dairies distributing in Vancouver. None of the patients had any concern with the slaughtering of cattle or hogs, although two kept their own cows, and another was a dairy farmer's wife. Our laboratory charts showed the dairies supplying these patients to have poor records in respect of the Brucella agglutinin titres of pooled whey samples. Moreover Br. abortus was isolated from the milk supplies of three of these patients.

In one instance (case no. 14, table VI) the micro-organism isolated from the patient's blood grew initially in air without added carbon dioxide. No other strain isolated by us from milk, or by blood culture, has grown in atmospheric air except after repeated subculture on artificial media. Except for this peculiarity, the strain in question conformed (in respect of its reactions to basic fuchsin, pyronin, and thionin) to the accepted criteria for Br. abortus rather than Br. suis. Morphologically and serologically, the strain fell definitely in the Brucella group. On two occasions, separated by an interval of several days, a bottle of milk from the dairy which had recently supplied this patient, was purchased over a shop counter. A micro-organism was readily isolated from each sample, having the identical characteristics of the strain isolated from the patient. Apart from the deliberate addition of a Brucella culture to previously sterilized milk, and the administration of milk so infected to healthy volunteers, it would be hard to secure a more convincing item of epidemiological evidence than this.

BACTERIOLOGICAL FINDINGS

In several of these cases, both patient and physician were so co-operative that repeated blood cultures could be made during the course of the disease. In six patients, Br. abortus was readily isolated (using the currently-approved techniques) from two or more successive blood specimens taken at irregular intervals. In three other cases, a positive culture was obtained from the single blood specimen received. One moderately ill patient, from whom four blood samples were obtained, gave negative cultures on each occasion. Four other acute cases, from each of whom only one blood sample was obtained, gave a negative culture, although their Brucella agglutinin titres were high. No blood sample was obtained from the one remaining patient. The laboratory findings and commentary notes on these patients are set forth in table VI.

DISCUSSION

The purpose of this paper has neither been to record special cultural and diagnostic methods, nor to report observations throwing new light upon the aetiology of brucellosis in man. Our intention has rather been to show how, within the

serious limitations of its working conditions, a public health laboratory can accumulate data bearing significantly upon the relationship of an infected milk supply to the incidence of brucellosis in the community. According to the latest official estimate (7), 78 per cent, of the milk distributed in Vancouver is pasteurized; but that 22 per cent. of the milk should be consumed raw was believed likely to occasion a high incidence of human brucellosis, in view of the local prevalence of contagious bovine abortion.

That local raw-milk consumers undergo no small risk of contracting *Brucella* infection is evident from the results of the specific agglutinin survey, carried out on the whey from monthly pooled-milk samples received from the 55 raw milk distributors in the city. In view of the difficulties anticipated in the isolation of *Br. abortus* from pooled milk, and of the fact that the micro-organism is in any event probably excreted intermittently by infected cows, no special efforts were made to determine the frequency with which the actual presence of living *Brucella* might be demonstrated in these milk samples. But when some unusual circumstance occasioned the attempt, *Br. abortus* was readily isolated from the milk of 6 dairies, of which 4 were city distributors. Culturally positive samples were obtained in two instances from milk showing complete agglutination in no higher than a 1:50 dilution of whey; while we have recently isolated *Br. abortus* from a local raw milk sample giving incomplete specific agglutination in a whey dilution of 1:25. Veterinarians are now learning to be suspicious of cattle showing *Brucella* agglutinins in a 1:25 dilution of blood serum; and our own findings on one small herd (table III) confirm the view generally held, that the *Brucella*-agglutinin titre of a cow's blood serum is usually higher than that of its milk serum. Hence, a whey agglutinin titre of only 1:25 is believed to be significant as an index of the possible presence of living *Br. abortus* in the milk; particularly when (as occurs with a pooled sample) a large dilution factor may mask the inclusion of milk from one or more severely infected cows in the sample. There would appear to be no immunological principle to prevent secretion of *Br. abortus* in milk having an agglutinin titre of less than 1:25, but none of the recorded cases of acute brucellosis was supplied with milk by any of the group of 3 dairies (table I) from which agglutinin-positive pooled milk samples had never been obtained.

In surveying the *Brucella*-agglutinin titres of human blood sera, we were not attempting to determine trends of incidence of brucellosis. We cannot, for instance, explain the especially high percentage of positive samples in 1935. The emphasis should be laid upon the finding, in one group, of 4.5 per cent. of positive sera over the whole six-year period, among a total of over 5,000 specimens tested. The choice of a 1:20 dilution of serum giving complete agglutination, may be questioned as a valid criterion of positivity. This dilution was arbitrarily chosen, and no claim is made that positivity (complete agglutination) at this dilution level necessarily indicates past or present *Brucella* infection. Before any

such claim could be considered, the effect of continued investigation of pasteurized milk containing large doses of dead *Br. abortus* upon the development of specific serum agglutinins, would clearly first need to be determined. Admittedly, neither experimental evidence nor clinical information is available to indicate what percentage of the 228 persons whose specific agglutinin titre we have termed positive, actually suffered past or present disability from *Brucella* infection. However, the fact remains that whereas only 0.57 per cent. of positive serum specimens were found among a group of persons living remote from Vancouver and its milk supply, the incidence of positive serum specimens was eight times as high among a large group of Vancouver residents who visited their physicians for one reason or another. The conclusion seems inescapable that the Vancouver group had been more exposed to *Brucella* agglutinogens than had the other group. Moreover, since the Vancouver specimens came from persons who had sought medical attention, it would seem justifiable to presume that the symptoms, in many at least of the 4.5 per cent. of persons showing *Brucella* agglutinins, were attributable to brucellosis. This presumption is strongly supported by the identification of 15 typical cases of acute brucellosis among persons drinking the local raw milk. Since such acute cases are as a rule more readily diagnosed than the subacute and chronic types of brucellosis, the clinically milder varieties of the disease were probably not identified. It may relevantly be stated that any community exposed to a raw milk supply from *Brucella*-infected herds, is likely to suffer a high incidence of vague illness, characterised by persistent slight fevers, recurrent headaches, neurasthenia, and rheumatic pains. Increased use of the intradermal (brucellergin) and phagocytic (opsono-cytophagic) tests for *Brucella* infection, as recommended by Huddleson (8), should lead to a specific diagnosis being more frequently made in many instances of this type.

The fact that many of the milder cases of brucellosis do not visit a doctor, and then when they do seek medical care their complaints are rarely attributed to this infection, has encouraged the raw-milk interests of Vancouver to minimize, and even to ridicule, the risk of contracting brucellosis by consumption of raw milk from infected herds. But the information herein recorded has already provided the basis for effective counter-propaganda. There has been no contention that the brucellosis hazard is the major argument for compulsory pasteurization of all milk; but we have lost no opportunity of reiterating to practising physicians, health officers, sanitary inspectors, public health nurses, bacteriology students, and welfare groups, that locally this disease has always appeared to be milk-borne. Some of the most effective proponents of pasteurization have proved to be former sufferers from acute brucellosis. Several local raw milk dairies have recently installed a pasteurizing plant, and the loss of former customers who had learned the aetiology of undulant fever from a friend or relative of a patient with this disease, is believed to have played no small part in bringing about this conversion. Finally, it seems pertinent to note that the findings recorded in this paper have undoubtedly helped to accelerate the formulation, by the local

medical and health organizations, of resolutions in favour of the compulsory pasteurization of all milk sold in Vancouver.

SUMMARY

Of 1,296 samples of pooled raw milk received at the Provincial Laboratories from 55 dairies distributing in Vancouver, 54.3 per cent. showed complete agglutination of a standardized *Br. abortus* suspension in whey dilutions of 1:25 or higher. Only 2 of the dairies (no longer in business) yielded whey samples which were consistently negative, according to this criterion; while from 9 dairies negative whey samples were never obtained.

The significance of these results is discussed and illustrated by reference to the isolation of *Br. abortus* from 6 local raw milk supplies, and also from the blood of 9 persons with acute brucellosis of apparently milk-borne origin.

Over a six-year period, a *Brucella* agglutinin survey was made, covering one group of 5,068 blood specimens sent in by Vancouver physicians for Widal tests. Of this group, 4.5 per cent. gave a complete agglutination of a *Br. abortus* suspension in a serum dilution of 1:20 or higher. By contrast, among blood specimens from an analogous group of 352 persons living remote from Vancouver, only 0.57 per cent. showed agglutinins in equivalent titre.

The main clinical findings in 15 typical cases of acute brucellosis were protracted fever, loss in weight, joint and muscle pains, headache, and depression. Leucopenia, with a relative lymphocytosis, was present in all cases. The final diagnosis was invariably made as a result of laboratory findings.

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REFERENCES

1. Jordan, E. O.: *J. Infect. Dis.*, 1931, 48, 526.
2. Johns, E. P., Campbell, F. J. H., & Tennant, C. S.: *Canad. M. A. J.*, 1932, 27, 400.
3. Hall, I. C., & Learmonth, R.: *J. Infect. Dis.*, 1934, 55, 184.
4. Huddleson, I. F.: "*Brucella Infections in Animals & Man*", Commonwealth Fund Monograph, New York, 1934.
5. Poelma, L. J., and Pickens, E. M.: *J. Bact.*, 1932, 23, 112.
6. Carpenter, C. M., and Boak, R. A.: *J. A. M. A.* 1932, 99, 296.
7. Report of Committee on Milk Control, *Canad. Public Health J.*, 1937, 28, 459.
8. Huddleson, I. F., Johnson, H. W., and Beattie, C. P.: *Technical Bulletin No. 149*, Michigan Agricultural Experiment Station, 1936, p.35.

FURTHER OBSERVATIONS ON BRUCELLOSIS
IN AND AROUND VANCOUVER

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In a former paper (1) evidence was presented bearing upon the brucellosis hazard entailed by the consumption of raw milk in and around Vancouver. Over a two-year period, fifteen local cases of clinically-acute brucellosis were shown by serological, cultural, and epidemiological methods, to have been milk-borne and due to *Br. abortus*. During this same period, milk samples taken monthly from every distributor of raw milk within the city, and brought to the laboratories by sanitary inspectors for routine coli-aerogenes tests and total colony counts, were also examined for whey agglutinins against a standardized suspension of *Br. abortus*. Of a group of 1,296 samples, 704, or 54 per cent., showed complete agglutination in whey titres of 1:25 or higher. Of 5,068 blood samples received over a six-year period from Vancouver physicians for Widal tests, 4.5 per cent. gave complete agglutinations of a *Br. abortus* suspension in a serum dilution of 1:20 or higher. A comparable group of serum specimens from persons in two communities remote from Vancouver showed only one-eighth as high an incidence of *Brucella* agglutinins.

No special efforts were made, in the above investigation, to isolate *Br. abortus* from "routine" milk samples from dairies which had supplied patients who developed acute brucellosis. These findings led us, shortly, after their publication; to begin attempts to isolate *Br. abortus* from pooled raw milk samples, collected officially by sanitary inspectors and brought by them to the laboratories for routine coli-aerogenes tests and total colony counts. At the outset (April-May, 1938) one pooled-milk sample was cultured from each of 32 dairies whose herds were adjudged to be the most heavily infected on the basis of consistently high-titre whey agglutinin records. Eight samples, or 25 per cent., yielded *Br. abortus*. Such a finding lent further weight to our uncompromising advocacy of compulsory pasteurization; but instead of adopting this measure, the local authorities decided that the human brucellosis hazard could be effectively controlled by the elimination of individual "reactors" from every herd supplying raw milk to the city. Advantage was taken of the opportunity afforded by this decision. Cultural and agglutinin surveys were carried out over the ensuing months, and the extent to which the local brucellosis hazard was diminished by the ostensible withholding from city distribution of raw milk from "reacting" cows, could thus be estimated. This communication records our findings over the eight months which have elapsed since the policy of "reactor" elimination was adopted, rather than that of enforced pasteurization.

METHOD OF ISOLATING BR. ABORTUS FROM MILK

The medium used in culturing milk for Br. abortus was Huddleson's liver infusion agar containing 1:200,000 crystal violet. Plates of this medium were spread with a few loopfuls of 24-hour standing cream, centrifuged cream, and centrifuged deposit respectively, obtained from 15 cc. of the milk sample, seven to nine plates being used in all for the sample. Plates were incubated for six days at 37°C. in an atmosphere containing 1-12 per cent. carbon dioxide. Suspicious colonies were then picked, their identity being confirmed by microscopic examination, their carbon dioxide requirements, their specific agglutinability in the presence of an anti-abortion serum of high titre, and by their susceptibility to fuchsin, thionin, and pyronin. The findings are set forth in table 1.

TABLE 1

ISOLATION OF BR. ABORTUS FROM POOLED RAW-MILK SAMPLES

MONTHS	NUMBER OF SAMPLES GIVING SATISFACTORY	NUMBER OF DAIRIES PLATES YIELDING Br. abortus
April-May, 1938	32	8
June-August, 1938	90	5
November, 1938, January, 1939	48	9

When more than half the plates spread with the various fractions of any one milk sample were too overgrown for satisfactory examination, the sample was excluded from consideration. In the April-May survey, the remarkably high percentage of positive cultures was no doubt due in part to the deliberate selection of samples among which the likelihood of successful isolation seemed greater. Over the period November, 1938-January, 1939, one sample was cultured from every raw milk distributor, irrespective of the whey agglutinin records of the dairies concerned. During the period June-August, on the other hand, two samples were cultured from every raw milk distributor. The lower incidence of positive cultures obtained throughout this latter period must in part be attributed to smaller inocula being spread on the plates to compensate for the higher total colony counts obtained during those hotter months; and in part to the recently-noted fact, that a slightly changed method of preparation of the medium, in use at that time, rendered it less satisfactory for the isolation of Br. abortus. Bearing these points in mind, the cultural findings indicate that no significant reduction in the brucellosis hazard was brought about by the measures adopted. It should be added that in several instances more than one positive milk sample was obtained from the same dairy during the periods under review and that such findings are not recorded in the table. One dairy yielded positive cultures over the eleven-months' period March, 1938, -January, 1939, from ten samples out of thirteen tested.

Determination of the whey agglutinin titres of routine samples taken at monthly intervals from all city raw milk distributors, suggests further that the attempts to eliminate reacting cattle failed almost entirely to accomplish their objective. In table 11 the whey agglutinin findings are grouped into various periods. Over the two-year period, March 1936-1938, during which no official efforts were made to identify "reactors" with a view to their enforced segregation, only 592 samples among a total of 1,296 (45.7 per cent.) failed to show complete agglutination, in 1:25 or higher dilutions of whey. Identification and segregation of reactors officially began late in May, 1938. It is apparent from the table that no significant improvement in the agglutinin situation took place over the successively ensuing periods; for during the eight months elapsing since control measures were put into effect, 199 samples among a total of 425 tested, or 46.9 per cent., failed to show complete agglutination in 1:25 dilution of whey. During this period, only six raw milk dairies, among a total of 53, showed definite improvement in their monthly whey agglutinin records; while three dairies whose records had previously been fairly good, began to show consistently high whey agglutinin titres.

In the past eight months, at least five cases of acute human brucellosis have occurred in the city, of whom three had regularly consumed raw milk from dairies with bad records in respect of either cultural or agglutination findings. A positive blood culture was obtained from one of these cases, a child of six years, whose raw milk supply had recently yielded a culture of *Br. abortus*. Again, the apparent incidence of the less acute types of brucellosis showed no significant reduction. Of 911 samples of blood received for routine Widal tests during the past eight months, 32 or 3.5 per cent., completely agglutinated a standardized *Br. abortus* suspension in serum dilutions of 1:20 or higher: whereas in the preceding five-months' period the corresponding figures were 21 out of 576 specimens, or 3.7 per cent.

Incidentally, the possibility that specific serum agglutinin titres of 1:20 or higher might be provoked in man by consumption of pasteurized milk containing dead brucellae, was shown to be very unlikely by the following experiment. Eight healthy volunteers drank increasing doses of a heat-killed suspension of a strain of *Br. abortus* recently isolated by blood culture from an acutely ill patient. Over a six weeks' period, a total of 23.6 cc. of a suspension corresponding to MacFarland No. 6 turbidity standard, or the equivalent of over 210 billion *Br. abortus*, was taken by mouth. Doses were taken at weekly intervals, the initial dose being roughly equivalent to 500 million brucellae, and the final dose 50 billion brucellae. None of the volunteers showed any detectable increase in serum agglutinin titre.

DISCUSSION

The foregoing findings are presented not with any intent to embarrass authorities who doubtless acted in good faith in choosing reactor elimination as a possible means of reducing the local human brucellosis hazard; but rather so that other similarly-situated authorities may perhaps be spared from attempting a costly, dilatory, impracticable, and at best only partially-effective control measure. The plan originally adopted was that veterinarians should do a blood serum agglutination test on all cows in dairy herds distributing raw milk in Vancouver. These tests were to be done twice monthly for three months, and subsequently at longer intervals, until all cows showing agglutination in serum titres of 1:100 or higher had been eliminated. But the tests were performed in many instances by quite inexperienced persons, and no standardization of antigen was attempted. Occasionally, a farmer would insist on unfavourable reports being checked in another laboratory, which might issue an entirely contrary report. Some dairies refused to cooperate from the beginning, while others which initially cooperated lost interest when they learned that their reacting cows had been bought by less scrupulous competitors. Again, it was only to be expected that a herd "cleaned up" following one survey, should show additional

reactors at a subsequent survey; but such experiences proved highly discouraging to farmers whose understanding of the principles underlying the tests was very slight.

Even if all the laboratories involved could have been relied upon to do satisfactory tests, using a standardized antigen, and even if farmers were then forced to segregate or slaughter their "reactors", brief consideration of the immunological principles involved leads to the conclusion that in dairying districts such as the Fraser Valley, where the incidence of bovine contagious abortion is extremely high, herds could not be thus freed from the infection except over a period of many years, and at great expense. Clearly, a cow may theoretically acquire the infection, excrete Br. abortus in the milk, and prove infective not only to other cows in the herd, but also to man, before blood or milk serum agglutinins have developed. Such a contingency is accepted by immunologists, but is not yet apparently recognized by the majority of veterinarians. We have ourselves isolated Br. abortus on a few occasions from the individual raw milk samples from cows having no specific agglutinins in 1:100 dilutions of either blood serum or whey.

Perhaps it is not surprising, in the light of the above findings, that a majority of the raw milk distributors themselves are now convinced that compulsory pasteurization of all city milk is the only means of effectively controlling the human brucellosis hazard.

REFERENCE

- (1) Dolman, C.E., and Hudson, V., Canad. Pub. Health J. 1938, 29: 236.

TABLE 11
WHEY AGGLUTININ FINDINGS AMONG ROUTINE POOLED-MILK SAMPLES

PERIOD COVERED BY TESTS	NUMBER OF SPECIMENS TESTED	NUMBER OF POSITIVE SPECIMENS	NUMBER AND PERCENTAGES OF POSITIVE SPECIMENS AT INCREASING TITRES			
			±	++	+++	++++
March, 1936-March, 1938	1,296	704	186 (26.4%)	275 (39.0%)	173 (24.5%)	70 (10.0%)
April, 1938-May, 1938	107	62	19 (30.7%)	30 (48.4%)	11 (17.7%)	2 (3.2%)
June, 1938-July, 1938	107	59	24 (40.7%)	19 (32.2%)	10 (16.9%)	6 (10.2%)
August, 1938-Jan. 1939	318	140	44 (31.4%)	54 (38.6%)	31 (22.1%)	11 (7.9%)

± = complete agglutination in 1:25 only
 ++ = complete agglutination up to 1:50
 +++ = " " " " 1:100
 ++++ = " " " " 1:200 or over

EXCERPTS FROM THE "MILK PROBLEM" IN THE
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FREQUENCY OF MILK-BORNE DISEASE IN HUMAN BEINGS
(Page 422-424)

Milk-borne disease is rarely obtrusive; unless it is looked for, it will not usually be found. To ascertain its true frequency in any country would require a combined epidemiological and bacteriological investigation covering every town and village and paying attention to practically every case of infectious bacterial disease. Needless to say, no such investigation has ever been undertaken, and our knowledge of milk-borne disease is therefore fragmentary and incomplete.

There are several reasons why this should be so.

(1) No disease is exclusively milk-borne. All the diseases that may be carried by milk may also be carried by other means, such as air, food, or water. In any particular disease, milk may be, and often is, an unusual source of infection, and the occurrence of cases of the disease in question does not therefore arouse an immediate suspicion that the milk is at fault. Too often, the common method of infection is taken for granted, and the possibility that the milk supply is infected is not even envisaged. Perhaps one of the most striking examples of this is afforded by the outbreak of septic sore-throat in August 1935 in Copenhagen. In spite of the magnitude of this epidemic, involving as it did about 10,000 persons, no suspicion of its milk-borne origin was aroused until attention was drawn to it by a careful epidemiological enquiry.

(2) Some types of pathogenic organisms in milk, particularly the tubercle bacillus and *Brucella abortus*, give rise to clinically detectable disease in only a very small minority of persons consuming the milk. This circumstance has led many ill-educated members of the laity, and even of the non-medical scientific professions, to express a doubt whether these organisms are in fact responsible for disease at all.

Such a doubt might have been justifiable fifty years ago, when current, bacteriological teaching on the causation of disease laid undue stress on the organism and practically neglected the reaction of the host. It was then assumed that the mere access of the organism to the tissues would result in an attack of the corresponding disease. Since then, we have learned a great deal about abortive attacks, sub-clinical infections, latent infections, healthy carriers, and so on, and we now know what many of the older epidemiologists realised long ago, that the occurrence of disease is only possible when accessory factors are at work to lower the resistance of the tissues, and hence permit the in vivo proliferation of the invading organism. Since the resistance of the tissues is determined in any individual by a multiplicity of factors of which we have at present only very imperfect knowledge, and since it varies from one individual to another, and even from time to time in the same individual, it follows that the reaction of any individual to infection with a particular bacterium is generally quite impossible to predict. When the bacterium is highly virulent, and gains access to a non-immune population, the majority of those exposed to risk will probably develop a typical attack of the disease. When, on the other hand, the bacterium is less virulent and is circulating in a population a large proportion of which is protected by a latently or overtly acquired immunity, only isolated persons, here and there, whose resistance for some reason or other is at a low ebb, are likely to suffer from the disease in its characteristic form. When it is further realised that the outcome of any bacterial onslaught is determined not only by the virulence of the organism and the resistance of the tissues but also by the numbers of the organisms in the infecting dose and the frequency with which the doses are repeated, some idea will be gained of the complexity of the equilibrium that exists between any given parasite and any given host.

(3) The occurrence of a long incubation period and a gradual onset in some milk-borne diseases, such as tuberculosis and undulant fever, serve to mask any direct relationship between the infection and the vehicle by which it was borne. It is, in fact, only within recent years that the very existence of undulant fever has been recognized, and that its frequent milk-borne origin has been proved.

(4) When a large epidemic of an infectious disease occurs with explosive suddenness, attention is very often directed to the milk supply. But when the disease is limited to a few families, particularly if they are scattered over a wide area or are attended by different doctors, or when it affects only one or two persons, the probability that milk will receive even a passing thought is very small.

(5) Sporadic cases and small outbreaks of milk-borne disease are often not reported at all, or are published only in the local medical officer of health's annual report. Without going through every such report in detail, the majority of these smaller outbreaks will be overlooked and will never be brought to the notice of the central authorities.

For these reasons, therefore, our knowledge of milk-borne disease is very defective, and we may confidently assume that the few figures we have got underestimate--sometimes grossly--its true frequency.

UNDULANT FEVER (Page 426-428)

Like tuberculosis of bovine origin, the existence of this disease can be proved only by bacteriological examination. Since many clinicians are still unaware of the role played by *Brucella abortus* in the causation of disease in man, and since the disease, when it does occur, is often so protean in its manifestations that a diagnosis of active *Brucella* infection is never even considered, any attempt to assess its frequency from clinical records is bound to lead to a gross underestimate. Moreover, in some countries, the disease is not reportable, and private enquiry can bring to light only a proportion of the total cases. The only satisfactory method is that which has been used with such conspicuous success in Denmark--namely, to estimate the number of active infections from the frequency distribution of agglutinins to *Brucella abortus* in the blood serum of pyrexial patients. To be completely satisfactory, this method requires that the sera of all patients suffering from pyrexia of doubtful origin should be tested against *Brucella abortus*, and that a record should be available of the results so obtained. In Denmark, where the general practitioner has been educated to use laboratory facilities, and where all sera are examined at one central laboratory, these two requisites are fairly well complied with. But in other countries, partly through the practitioner's failure to make full use of the laboratory, and partly on account of the existence of multiple laboratories which are under no obligation to examine blood sera for agglutinins to *Brucella abortus* or to report their results to any central authority, the difficulties of obtaining satisfactory figures are very much greater. What figures are available are given in Table 10.

Table 10.--Proportion of Sera from Febrile Patients
Agglutinating *Brucella abortus* to 1/80 or over,
and Estimated Annual Number of Undulant Fever
Cases about 1930 (taken from Topley and Wilson, 1936).

Country	No. of Sera Examined	Number Positive	Percentage Positive	Estimated Annual No. of Undulant Fever Cases	Number of Cases per 1,000,000 Population
Great Britain	3,175	101	3.18	440	11
Germany	9,397	323	3.44	600	10
Austria	9,693	177	1.83	50	8
Switzerland	1,503	91	6.1	340	84
Netherlands	4,500	50	1.11	90	12
Denmark	4,623	500	10.82	500	147
Sweden	120	20

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It will be seen that Denmark has much the highest incidence per 1,000,000 of the population. To what extent this is due to the factors we have just considered it is impossible to say, but it seems doubtful whether better diagnosis can account for such a big discrepancy between the figures for Denmark and those for Great Britain, Germany, Austria, the Netherlands and Sweden. The high incidence of undulant fever in Switzerland is of special interest, and suggests that the boiling of milk in the home is not as widely practised as it is sometimes stated to be.

Though it is probable that practically all infection of man with *Brucella abortus* is derived from the cow, not all of it is due to the consumption of raw milk. Some of it undoubtedly follows direct contact infection with diseased cows. This mode of infection is particularly likely to occur in veterinarians, farm workers and slaughterers. Apart from these three occupations, it would appear that practically all other classes of the population are infected by milk. The importance of milk-borne infection is further borne out by the fact that in Great Britain, for example, the majority of recognized cases have occurred in town workers who have never had any direct contact with sick animals. Moreover--and this is a very striking piece of evidence--in cities like London, where over 90% of the milk supply is heat-treated, the few cases of undulant fever that have occurred have been in patients who have consumed certified, grade A, or other types of raw milk.

In this connection, we may point out that neither butter nor cheese appears to be of any considerable importance in the causation of tuberculosis or undulant fever. Except on farms, butter is almost invariably made from pasteurised cream, while, in hard cheese, both the tubercle bacillus and *Brucella abortus* are usually dead some considerable time before the ripening process is complete. Only in farm-made butter and in soft cheese are these organisms likely to be found alive. The vast majority of milk-borne tuberculosis and undulant fever is undoubtedly due to the consumption of raw milk or cream.

THREE OBJECTIONS TO PASTEURISATION PROPOUNDED BY RAW MILK MEN (Page 447-451)

(1) That Compulsory Pasteurisation would adversely affect the Producer's Price.--This argument has been carefully examined by Wright (1933) who concludes that, so far as Great Britain is concerned, it is without foundation. In fact, there is no evidence to show that pasteurisation per se has any effect on the producer's price. The same likewise appears to hold for Canada and the United States, where pasteurisation has been enforced in many cities for some years. It is true that the producer--retailer may suffer, because the necessity of pasteurising his milk will diminish his net profit. But we can see no reason why he should obtain a greater remuneration for selling raw milk in a potentially dangerous state than the large dairy companies who go to a considerable expenditure in order to render it safe. Even in Great Britain, the producer-

retailors contribute only about 17% of the milk sold for liquid consumption, while in Scandinavia, the Netherlands and Switzerland they hardly exist at all. It is difficult to understand why the public health of the nation should be sacrificed to the economic interests of a small section of the farming community.

(2) That Compulsory Pasteurisation would remove the Stimulus to the Eradication of Diseased Animals from Milking Herds.--This argument is based on a fundamental confusion of the veterinary and medical aspects of the milk problem. It endeavors to place the whole onus of paying for disease eradication in the herds on the consumer of liquid milk, assuming--quite erroneously--that milk from disease-free herds can safely be drunk in the raw condition. In certain countries, the veterinarian tries to dictate to the public health official, to tell him what milk is safe for human consumption, and to insist that the consumer should pay a higher price for milk from disease-free herds. Instead of demanding directly that the herds should be freed from disease for their own sake, he endeavors to shift this responsibility to the public health service, which is no more directly concerned with animal health than the veterinary service is with human health. The public health official knows perfectly well that milk from disease-free herds is open to contamination from human carriers and cases of disease, from water and possibly other sources, and cannot be regarded as safe for distribution in the raw state. Even if the herds of Europe were completely freed from tuberculosis, contagious abortion and mastitis--a prospect that cannot possibly be envisaged in our lifetime--it would still be necessary to pasteurise all milk that was to be supplied to a population of any size. The public health official, if he is honest, tells the consumer that milk from tuberculin-tested herds cannot be regarded as completely safe, and that he had much better buy pasteurised milk at a lower price than raw milk from tuberculin-tested herds at a higher price. The problem of supplying the public with a safe milk is not dependent on the eradication of disease from the milking herds, however much this may be desirable on other grounds. This does not, of course, mean to say that if milk is to be drunk raw, milk from disease-free herds is not to be preferred to milk from ordinary herds, but it does mean to say that pasteurised or boiled milk from ordinary herds is safer than raw milk from disease-free herds. The ideal is obviously pasteurised milk from herds that are free from disease. With water, milk or any other article of food, the stringency of the precautions taken to ensure the safety of the supply must depend on the size of the population exposed to risk. So far as milk is concerned, pasteurisation of the supply to any urban population must be regarded as indispensable.

It is high time that the confusion of thought existing, for example, in Great Britain was cleared up. The eradication of disease from the milking herds must be justified on agricultural and veterinary grounds alone. If it can be shown that animals which are free from disease are healthier, more fertile, produce more milk, and fetch a higher price in the market or the slaughter house than animals affected with tuberculosis, contagious abortion, mastitis or John's disease, then the eradication of these diseases is economically desirable,

altogether irrespective of whether or not the milk is to be consumed in the liquid state by the human population.

Summarising, we may say that the eradication of disease from the herds is essentially an agricultural and veterinary problem and should be undertaken on economic and not public health grounds. The provision of a safe milk supply to the human population is essentially a public health problem and can be solved satisfactorily only by compulsory pasteurisation. The two problems should be kept distinct, and the eradication of animal disease should not be made contingent on the payment by the consumer of a higher price for milk from disease-free herds. It is interesting to note that the same conclusion is reached in the report of the Milk Reorganisation Commission (1936b).

(3) That Pasteurisation diminishes the Nutritive Value of the Milk.--This statement continues to be made in spite of any adequate scientific evidence to support it. The very thorough examination by Stirling and Blackwood (1933) of the literature dealing with this subject failed to reveal any significant difference between the nutritive value of raw and pasteurised milk. It is true that pasteurisation frequently causes a diminution in the vitamin C content, but this substance is, as we now know, very unstable and disappears spontaneously from raw milk under the influence of light and aeration. Paediatricians are agreed that neither the vitamin C, nor, in winter, the vitamin D, content of cow's milk is sufficient to satisfy the requirements of the growing infant, and that whether milk is given raw, pasteurised, boiled or dried, an extra source of vitamins C and D must be provided.

Considering the extensive use that has been made for several years of pasteurised milk in the feeding of infants, it would be surprising if any inferiority in the nutritive value of this type of milk had not become evident by now. No such evidence, however, is available. On the contrary, Frank and his colleagues (1932), who enquired into the histories of over 3,700 children in the United States, failed to find any significant difference in the height or weight of children who had received heated, and children who had received raw milk.

If pasteurisation did produce any real diminution in the nutritive value of the milk, this fact should be rendered evident more easily by feeding experiments on calves than in any other way. McCandlish and Black in 1935 and Wilson, Minett, and Carling in 1937, did such experiments. There was a slight advantage in favour of the animals fed on pasteurised milk.

Taken separately or in conjunction there is nothing in these two experiments to suggest that the nutritive value for calves of holder pasteurised milk is in any way inferior to that of raw milk. The fear that pasteurisation was detrimental to the food value of the milk has undoubtedly deterred many doctors in the past from supporting compulsory pasteurisation. This fear appears to be entirely groundless and should now be removed to the limbo of disproved and forgotten prejudices.

RAW MILK NEVER SAFE

(Page 496-497)

No raw milk can ever be regarded as completely safe for human consumption. Even if produced from healthy animals, milk is so subject to contamination from human and other sources that it must always be regarded in the raw state as a potentially dangerous article of food. The only satisfactory method of ensuring the final safety of the product is to submit it to some form of heat treatment that can be relied on to destroy any pathogenic organisms that may be present. It is our considered and emphatic opinion that all liquid milk for human consumption should be adequately pasteurised or boiled.

Though many pseudo-scientific objections have been advanced against pasteurisation, we have been unable to find any that is supported by adequate evidence. On the other hand, there is a considerable amount of evidence to show that, when pasteurisation has been introduced on a large scale, milk-borne disease has been practically abolished. There is reason to believe that, if pasteurisation were rendered compulsory for all towns, infection derived from milk would be completely prevented. In country districts, where compulsory pasteurisation is impracticable, insistence should be laid on the necessity of boiling milk prior to consumption.

U. S. Public Health Service

Sanitation Section

MILK AND ITS RELATION TO DISEASE

by

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(Delivered before Philadelphia College
of Physicians, Feb. 5, 1940)

Incidence of Milk-Borne Disease

Each year between 30 and 50 outbreaks of milk-borne disease have been reported to the Public Health Service by State and local health authorities in the United States. For the 15-year period from 1923-1937 inclusive, 639 milk-borne outbreaks were reported, involving 25, 863 cases and 709 deaths. In the Order of their importance the diseases included were: (1) typhoid fever, with 369 outbreaks, 6,461 cases, and 486 deaths; (2) septic sore throat, with 75 outbreaks, 9,467 cases, and 117 deaths; (3) scarlet fever, with 84 outbreaks, 5,725 cases, 52 deaths; (4) dysentery and enteritis, with 34 outbreaks, 1,506 cases, and 26 deaths; (5) paratyphoid fever, with 23 outbreaks, 1,029 cases, and 22 deaths; (6) diphtheria, with 13 outbreaks, 179 cases, and 4 deaths; and (7) miscellaneous diseases, including food poisoning, with 41 outbreaks, 1,496 cases, and 2 deaths.

It should be noted that this compilation does not include sporadic cases of typhoid fever, scarlet fever, septic sore throat, etc., since sporadic cases have rarely been given sufficient epidemiologic study to determine the role of milk and milk products in their causation.

Nor does this compilation take any note of such diseases as bovine tuberculosis, undulant fever, or infantile diarrhea, which are largely milk-borne, but which generally occur as sporadic cases rather than in epidemic form. Park and Krumwiede's (1) figures indicated that in 1913 in some regions about one-fourth of all cases of tuberculosis in children under 16 years of age were of bovine origin; and Rosenau (2) estimated that perhaps 7 percent of all tuberculosis in man was of bovine origin. Today, as a result of widespread tuberculin testing of cattle and increased use of pasteurized milk, these figures are undoubtedly no longer applicable to the United States.

As for undulant fever, or brucellosis, it is difficult to estimate the incidence. In 1937 about 2,500 cases were reported in the United States.

Evans (3) states: "We do not know what percentage of the total number of acute cases the reported cases represent. The data on which the number of chronic cases in this country might be estimated is very meagre. We only know that the chronic disease rarely receives the correct diagnosis. If all milk were efficiently pasteurized or boiled before being consumed, there would be no brucellosis except in those occupational groups whose work brings them into contact with infected animals or infected carcasses."

Milk is especially adapted to the needs of the young and growing individual, and has come to be looked upon as the ideal food from the standpoint of completeness, digestibility, and cost. Any teaching that might curtail the consumption of milk or its products would result in more injury than benefit. The reason for discussing milk-borne disease at this time is not to discourage milk consumption but rather to create in the milk-consuming public the milk producers, and the medical profession a proper appreciation and demand for an adequately safeguarded milk supply.

Why No Raw Milk Can Be Guaranteed As Safe

Why cannot raw milk be guaranteed as safe? The answer is, first, that even frequent sanitary inspections of dairies will not insure that infected bottles have been properly sterilized, that a safe water supply is used for cleansing milk utensils, and that milk containers have not been contaminated by flies. And, secondly, the answer is that frequent health examinations of herds and of milk handlers sometimes fail to disclose disease or carrier conditions that may be present.

It may be of interest to outline the mode of transmission of three types of milk-borne disease -- undulant fever, typhoid fever, and septic sore throat. What precautions, short of pasteurization, can a dairyman take to insure that none of his customers will ever contract any of these diseases by drinking his milk?

In the case of undulant fever, the only recourse open to the dairyman is to have his cows tested for Bang's disease and to slaughter the reactors. Certainly the slaughtered cows will no longer be a menace to his customers. Since repeated testing is required to maintain a herd free from Bang's disease, the dairyman will retest his cows six months or a year later, and it would be not at all unusual if he discovered another reactor. He would then be faced with some very serious questions: How long had the cow been discharging the Brucellosis organisms in the milk? How many of his customers had consumed his milk supply raw and had contracted the disease? How could he be certain that the same menace would not be disclosed at the next retest?

Turning now to typhoid fever, if one of the milkers contracts this disease, the dairyman will at once have him quarantined or sent to a hospital. Even if this were done as soon as the disease was properly diagnosed there is no assurance that the milker had not in the meanwhile infected the milk. The fact that milk-borne outbreaks of typhoid fever are sometimes traced to a case on the farm indicates that the infection may actually follow this path. More often, however, milk-borne typhoid fever epidemics are caused by carriers rather than by cases. Such a carrier is an individual who has had typhoid fever perhaps many years ago and who, though exhibiting no symptoms of illness, still carries typhoid fever organisms in his gall bladder or elsewhere, from which they are occasionally discharged with his feces or urine. The organisms may thus accidentally find their way to his hands, his clothing, and eventually to the dairy equipment and to the milk supply. Perhaps the most dangerous feature is that the typhoid carrier is often unaware of his condition and may continue to work at the dairy until irreparable damage has been done.

In view of these facts, what can a raw-milk dairyman do to keep typhoid fever out of his milk supply? His most promising course is to send samples of the feces and urine of all employees to the health department laboratory, as required by the Public Health Service milk ordinance for all handlers of grade A raw milk who give a history of typhoid fever. If the laboratory finds any positive specimens, the solution is obvious. If, however, the specimens are negative for typhoid fever, as is usually the case, the dairyman can not be certain that none of his employees is a carrier, as it is a well-known fact that many typhoid fever carriers discharge the organisms intermittently only and at irregular intervals. Even if samples are taken and examined on three separate days, the carrier condition can easily be missed until it is dramatically disclosed by a typhoid fever outbreak among the dairyman's customers.

In the case of the third type of milk-borne disease--septic sore throat--What steps can a raw-milk distributor take to prevent its transmission through his milk supply? There is no satisfactory answer. A milker with a common cold may later prove to have septic sore throat. Until his illness is properly diagnosed he may remain at work and infect the milk supply directly, or he may infect a cow's udder during milking. In the latter case the cow may develop an apparently ordinary case of mastitis, but her milk may be teeming with hemolytic streptococci long after the milker has recovered. Even if every milker's throat and every cow's udder were examined and cultures taken daily (a procedure which would, of course, be impracticable because of the expense entailed), the danger could not be averted because by the time the report came back from the laboratory some of the milk would have been consumed.

The three diseases just discussed illustrate three different modes of transmission of milk-borne disease, as described by Frank (4). Brucellosis is a disease of cattle as well as of humans; the typhoid fever enters the milk from human cases or carriers; the organisms of septic sore throat originate in humans and may enter the milk directly, or they may cause mastitis in

cattle and enter the milk indirectly. These are not theoretical descriptions. Epidemics of the types outlined recur year after year, even from certified and grade A raw milk. Slaughtering the diseased cows, discharging the employee who is a typhoid carrier, even frequent examinations of milkers and of herds, can not undo the damage already done. These measures may reduce the hazard but cannot eliminate it.

It seems impossible, then, to escape the conclusion that all milk should be either pasteurized or boiled to make it safe.

Proper Pasteurization Protects against All Milk-Borne Disease

Pasteurization is usually done at 143 degrees F. for 30 minutes, sometimes at 160 degrees F. for 15 seconds. Both of these methods are recognized by the milk ordinance recommended by the U. S. Public Health Service (5) for local adoption. That raw milk can and does transmit disease and that proper pasteurization prevents such transmission has been proved to the satisfaction of health authorities by laboratory and commercial scale experimental work, by epidemiologic methods, by statistical methods, and by animal experimentation.

All milk-borne pathogens are killed at 143 degrees F. for 30 minutes and at 160 degrees F. for 15 seconds. The following thermal death points of various pathogens in milk taken from the literature. B. tuberculosis: at 155 degrees F. in 1 minute and at 142 degrees F. in 10 minutes (6). B. typhosus: at 142 degrees F. in 7 minutes (6). B. diphtheriae: at 140 degrees F. in 10 minutes (7). Streptococci: all of 200 strains of hemolytic streptococci from septic sore throat and scarlet fever were killed at 140 degrees F. in 30 minutes, most of them at 136 degrees F. or less (8). Br. melitensis and Br. abortus: 13 strains of human, bovine, and swine origin were all killed at 140 degrees F. in 10 minutes (8). B. dysenteriae: killed at 140 degrees F. within 10 minutes (9).

It is difficult to determine the reduction in milk-borne disease due to pasteurization as distinguished from other concurrent public health measures, but a number of examples may be cited.

A classical illustration, and perhaps the most striking example of the immediate effect in the reduction of diarrheal diseases of infants by the pasteurization of milk, is that which occurred in a children's institution on Randall's Island, New York City, where a mortality rate of 44 was promptly reduced to 19 with no hygienic measures put into operation other than the pasteurization of all milk (10).

In 1921 a family in a northern county of Illinois with 4 cases of typhoid fever sold milk to 3 neighbors, all of whom developed the disease. The same milk was shipped to Chicago, where it was pasteurized, and no cases are known to have resulted. In an outbreak at Richmond, California, in 1915, 12 cases occurred on a route selling 90 gallons of milk daily. During the same period this dairy shipped 600 gallons daily to Berkeley, where it was pasteurized, and no typhoid occurred. Similar examples of part of an infected supply being rendered harmless through pasteurization are noted in the outbreaks at St. Charles Township in Kane County, Illinois, in 1921, also in central New York State in 1922, and at Denver, Colorado, in 1926 (11).

Dr. John L. Rice (12) reports that "more than 4,000 children under 5 years of age died each year in New York City from infant diarrhea in the early 1900's -- about one child in every 100 of that age group; but now this scourge of childhood is a thing of the past. In 1934 there were only 142 deaths from infant diarrhea in New York City. Had the rate of 1901 continued to prevail in 1934 there would have been 4,790 deaths. This remarkable decrease began as soon as the department of health in 1912 made the pasteurization of the city milk supply compulsory."

In 1907 when pasteurization by the holding method was first set up in Boston, there were 760 deaths of children under 2 yrs of age due to diarrhea and gastroenteritis. In 1935, with 99.8% of the milk supply pasteurized there were only 49 such deaths(13).

The Public Health Service compilation of milk-borne disease outbreaks for the 16 year period 1923-1938 indicates that about 95 percent of the outbreaks and of the cases involved were from raw milk and milkproducts. Since about 30% of the milk used during this period was raw, the risk from contracting disease from raw milk was about 50 times as great as from pasteurized milk. Even certified raw milk has been responsible for outbreaks. It is a most significant fact, however, that no outbreak has ever been reported as due to grade A pasteurized milk in any city operating under the milk ordinance recommended by the Public Health Service. In outbreaks attributed to "pasteurized" supplies the evidence points to breakdown of the pasteurizer, or bypassing of raw milk, or inadequate temperature or time of pasteurization, or post-pasteurization infection.

That the value of pasteurization is being increasingly recognized by the milk-consuming public is shown by the progress made in the percentage of the milk supply that is pasteurized. A survey made by the Public Health Service showed that, in 1936, 75% of the total milk supply of all municipalities of over 1,000 population in the United States was protected by pasteurization (14). For the largest cities, those over 500,000, the percentage was 97.5; for the smallest municipalities, those between 1,000 and 2,500, the percentage pasteurized was less than 25.

In 135 municipalities all market milk was pasteurized in 1936, including 65 in which pasteurization was compulsory. There were 41 additional municipalities in which all market milk was pasteurized except certified milk. There was a steady increase in the percentage of pasteurization between 1923 and 1936, particularly in the smaller communities, but most of the milk in the smaller communities is still raw, and it is almost entirely from small towns and from institutions that milk-borne disease outbreaks are reported.

Objections to Pasteurization Are Unsound

Various objections have been raised to pasteurization. One argument is that pasteurized milk is poor milk that has been rescued by pasteurization. This was probably true in the early days of pasteurization, but it is not true in the many communities operating under the Public Health Service milk ordinance or under the ordinances which have set high sanitary standards for the production of milk to be used for grade A pasteurized milk.

The next argument against pasteurization is that the process impairs the flavor of the milk. This can be easily disproved (15). In order to disprove this claim the health officer should first satisfy himself that the local pasteurization plants are strictly observing the Grade "A" pasteurized milk requirements of the Public Health Service Milk Ordinance and Code, and that the milk is being neither over-pasteurized nor exposed to copper, either of which sometimes produces off flavors. Then he may break down the flavor prejudice against pasteurization by arranging for flavor determination contests. One of the local pasteurization plants may furnish both raw and pasteurized milk in quart bottles to the Rotary, Kiwanis, or other civic luncheon clubs, the bottles being marked with distinguishing marks unknown to the drinkers. Each member should be provided with six glasses, placed in a row in front of him. A small portion of pasteurized milk should be placed in three of the glasses and a small portion of raw milk should be in the other three in an order unknown to any one but the health officer. The members should not be told how many glasses contain pasteurized milk. Then each member should be asked to tell by tasting which of the six glasses contained the pasteurized milk. It is fundamentally important that the raw and the pasteurized milks be identically the same milk except for the fact of pasteurization. This condition is best accomplished by obtaining the raw milk directly from the pasteurizer just prior to the pasteurization process, but after thorough mixing, and then obtaining the pasteurized milk from the same batch of milk after the pasteurization process has been completed.

If pasteurization really imparted an undesirable flavor to milk a large proportion of the members should be able to give correct answers. The speaker should ask all members who really believe they can distinguish the flavor to rise and state their opinion.

There will be only a few members who will make this claim, since the flavors are really indistinguishable; and since these members will be merely guessing, the number of them who will guess correctly will depend purely on the laws of chance. The mathematical chance of guessing correctly in this case is about three or four out of one hundred.

It will thus become apparent to all of the membership that pasteurization really does not impart an undesirable flavor to milk, and the results of the test may then be published in the newspapers.

The remaining argument is that pasteurization impairs the food value of milk. Most of us have known that the pasteurization temperature is destructive to vitamin C, though we have insisted that this vitamin is present in undependable and irregular quantities in milk anyway, and that orange juice is a much better source of vitamin C than milk.

But there has been a widely distributed attempt to convince the consumer that heating milk seriously affects its wholesomeness and growth-promoting power.

In order to test this out, the Public Health Service a few years ago studied the history of over 3,700 children, 1,921 of which had received no milk except heated milk, and 1,836 of which had received raw milk for more than the latter half of their lives (16). It was shown that over a considerable part of the age-weight curves the heated milk group of children shows a slightly greater average weight than the raw milk group, the average weight of the children receiving raw milk being 33.2 pounds, whereas the average weight of the children receiving heated milk is 33.6 pounds, a difference of 1.2% in favor of the heated milk group.

A study of the age-height curves showed that the curves of the two groups are practically identical. The raw milk group shows an average height of 37.4 inches, while the heated milk group shows an average height of 37.5 inches, a difference of less than three-tenths of one percent, again in favor of the heated milk group.

Studies of race, financial status, and supplementary foods showed practically no difference between the two groups of children except in the case of cod liver oil feeding. The raw milk group received cod liver oil during only 27.6% of the average child life, whereas the heated milk group received cod liver oil during 41.6% of the average child life. As this might have obscured a real difference in favor of raw milk in the preceding curves, the children who had received heated milk were regrouped into two sub-groups, namely, one group which had received cod liver oil for more than half of their lives, and the other group which had received no cod liver oil at all. which had received raw milk for more than t

As a result of these supplementary studies it was found that the former group gave an average weight of 33.8 pounds, too slight a difference to depress the former heated milk curve below the raw milk curve.

One other important bit of information was secured from the studies, namely, that the parents of the children receiving predominantly raw milk reported a higher incidence of diphtheria, scarlet fever, intestinal disturbances, and rickets than did the parents of children receiving heated milk only. The respective case rates for diphtheria were 17.1 and 22.7 per thousand, for scarlet fever 23.0 and 41.4 per thousand, for intestinal disturbances, exclusive of diarrhea, 11.0 and 196.0 per thousand, and for rickets 31.5 and 51.1 per thousand.

From the above studies it may be stated emphatically, therefore, that there is no foundation to the argument that the pasteurization of milk impairs its growth-promoting properties.

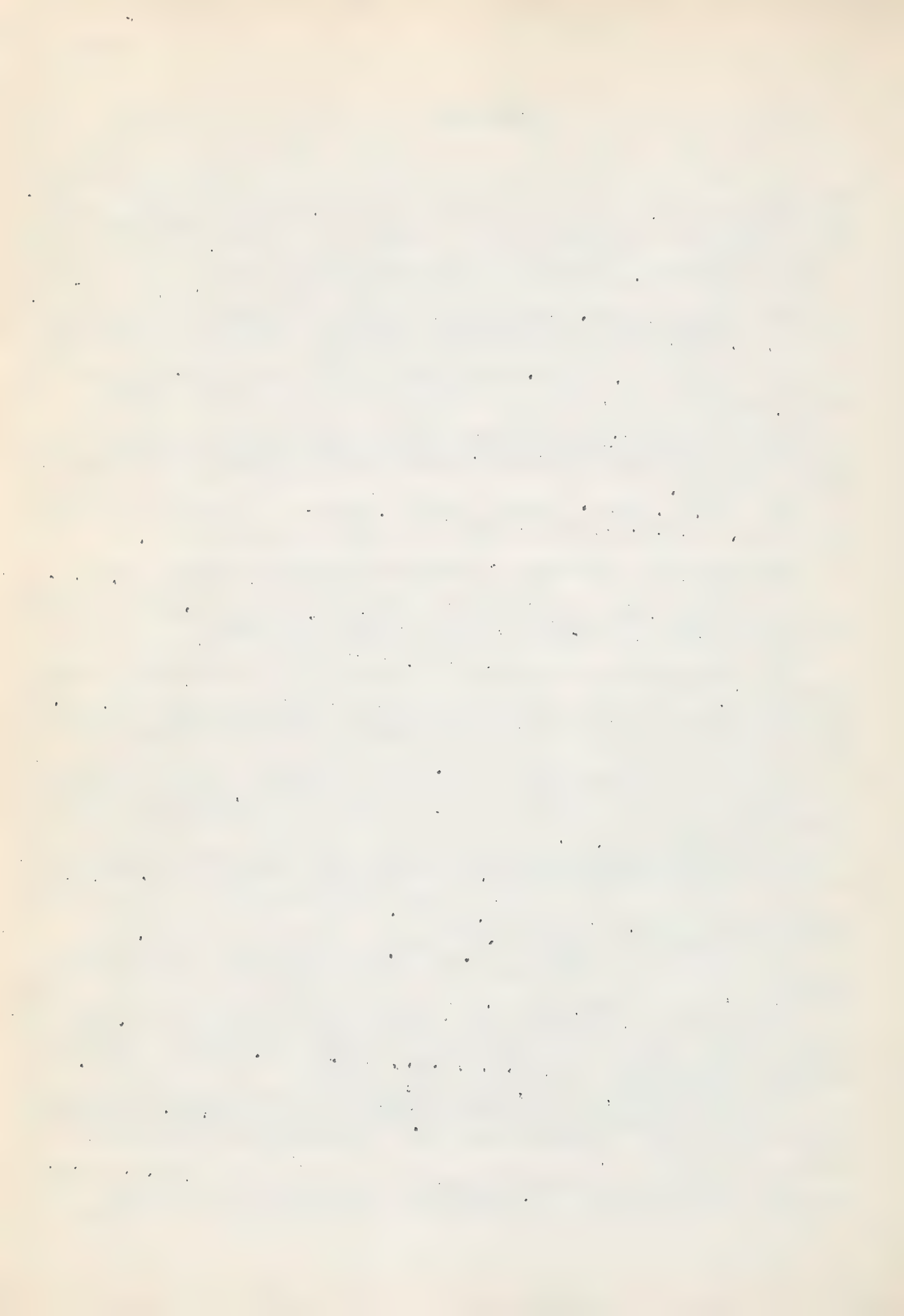
All Milk Should be Pastourized Or Boiled

It may be asked, if pasteurization is really so desirable, why the Public Health Service Milk Ordinance, which is now in effect in over 2,200 communities (17), permits each community to decide for itself which grades of milk it will permit to be sold, instead of requiring the pasteurization of all milk. The answer is simply that if the ordinance were so worded only a small percentage of cities could be induced to adopt it. It was considered wiser to frame the ordinance so as to make it adaptable not only to cities which were ready for the pasteurization of all milk but also to the many other communities in which there still persists a strong sentiment against pasteurizations. In the latter group this ordinance will at least provide the maximum protection afforded by the raw milk precautions alone. Pending the time when the pasteurization of all milk can be required by ordinance, health officers should persistently urge the consumption of pasteurized or boiled milk only.

In closing may I again point out that every sanitary precaution with which milk is surrounded, including pasteurization, is of course subject to slips in operation. Health examinations of herds and employees occasionally fail to disclose existing disease or carrier conditions, and even frequent sanitary inspections do not prevent occasional violations, both at producing farms and at pasteurization plants. However, the one thing which differentiates pasteurization from all other protective measures is that while all other measures may fail to protect completely even if they are properly applied, pasteurization will always protect if it is properly applied.

References

- (1) Park and Krumwiede. The relative Importance of the Bovine and Human Types of Tubercle Bacilli in the Different Forms of Tuberculosis. Collected Studies from the Research Laboratory, Department of Health of New York City, Vol.7, pp.88-92, 1912-1913.
- (2) Rosenau. Preventive Medicine and Hygiene.
- (3) Alice Evans. Brucellosis (Undulant Fever). Prepared for U. S. Public Health Service (multigraphed release) July, 1938.
- (4) Leslie C. Frank. What Every Person Should Know About Milk. Supplement No. 150 to the Public Health Reports. 1939.
- (5) Milk Ordinance and Code Recommended by the United States Public Health Service. Public Health Bulletin No. 220, 1939 edition.
- (6) W. H. Park. Thermal Death Points of Pathogenic Bacteria in Milk. A.J.P.H., XVII, 1:36, Jan. 1927.
- (7) Park and Williams. Pathogenic Microorganisms.
- (8) W. H. Park Thermal Death Points of Streptococci. A.J.P.H. XVIII, 10:1259, Oct. 1928, and XX, 5:503, May 1930.
- (9) Zinnser and Bayne-Jones. Textbook of Bacteriology, 7th edition.
- (10) Report of the Committee on Milk Production and Control, White House Conference on Child Health and Protection, p. 13.
- (11) Armstrong and Parran. Further Studies on the Importance of Milk and Milk Products as a Factor in the Causation of Outbreaks of disease in the U. S. Supplement No. 2 Public Health Reports, 1927, p. 8.
- (12) 1935 Annual Report of the New York State Association of Dairy and Milk Inspectors.
- (13) Report of Committee on Milk Plant Practices. J1, of Milk Technology, 1:38-43, Sept., 1938.
- (14) Fuchs and Frank. Milk Supplies and Their Control in American Urban Communities. Pub. Health Bulletin No. 245, 1938, p. 25.
- (15) Leslie C. Frank. The responsibilities of Health Authorities & Physicians with Reference to the Pasteurization of Milk in Communities in Which Pasteurization is Not Compulsory. Mimeographed publication, U.S.P.H.S., Nov. 1932.
- (16) Frank, Clark, Haskell, Miller, Moss, and Thomas. Do Children Who Drink Raw Milk Thrive Better Than Children Who Drink Pasteurized Milk? Reprint No. 1549 from the P. H. Reports of Sept. 23, 1932.
- (17) List of American Communities in Which the Public Health Service Is in Effect. Multigraphed publication, U.S.P.H.S.



WHAT EVERY PERSON SHOULD KNOW ABOUT MILK

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Of all things of life which affect human welfare none is more important than food. Food is to man what coal is to the furnace or gasoline to the automobile. Food furnishes man with internal heat, without which even overcoats would not keep him warm. Properly selected food provides mankind with the mental and physical energy which has been the mainspring of all civilization, it repairs the structural damage which the wear and tear of life inflict upon our bodies, and it helps make us resistant to disease. On the other hand, improperly selected food is responsible for a large proportion of human ills, from a simple stomachache to the shortening of life itself. In short, food is all-important in the human economy.

Of all of the kinds of food none is more important than milk, the principal food of infants and small children. There are three important questions about milk which every person should be able to answer. They are:

- (1) Why is milk such an excellent food, and how much of it should be included in the diet?
- (2) How can milk be safeguarded to prevent it from transmitting disease?
- (3) How can consumers be certain that the milk they drink has been thus safeguarded?

(1) WHY IS MILK SUCH AN EXCELLENT FOOD, AND HOW MUCH OF IT SHOULD BE INCLUDED IN THE DIET?

In the first place milk is the only food specifically prepared by nature for the young of mammals. Nearly everyone will immediately agree that a substance specifically prepared by nature for no other purpose than for food is most likely to contain the food elements needed to sustain life and justly deserves the title recently conferred upon it, namely, "the most nearly perfect food."

It is by no means sure that we know all of the attributes which the perfect food should have, but we can at least discuss some of them.

It will be obvious that one of the most important attributes which a food should possess is that it be a good source of energy, since every living thing needs a fresh supply of energy every day. Milk is such a food and, furthermore, is a cheap form of energy. The equivalent energy value in the form of certain other widely used foods is more expensive.

Milk is also a good muscle builder. It is rich in protein, which is required for muscle building. A child cannot grow and form strong muscles without protein. A full-grown

adult cannot keep in health without it. As to the quantity of protein available in milk, Rose states: "A quart of milk yields more than an ounce of pure protein of the highest quality," that is, more than one-third of the total daily protein requirement of an adult.

Again, milk is a good tooth and bone builder, for it contains plenty of lime. Children particularly need lime, and the lime should be in a form which is easily utilized by the body. This is above all true of the lime in milk. One cup of milk contains as much lime as $3\frac{1}{2}$ cups of carrots, 7 eggs, or 42 slices of bread.

Milk is a far more concentrated food from the standpoint of solids than most of us imagine. We think of milk as a liquid not much above the consistency of water; but it contains 13 percent of solids by weight, which is more than is contained in onions, beets, carrots, squash, pineapple, turnips, oysters, cabbage, radishes, cauliflower, spinach, watermelon, pumpkin, tomatoes, asparagus, celery, lettuce, or cucumbers. When we buy 1 pint or 1 pound of milk, therefore, we buy more actual dry solid food than when we buy 1 pound of any of the other above-mentioned foods.

Milk is also an excellent source of fat. This, of course, is obviously in the form of cream, which, with the milk sugar, is directly related to its fuel value.

Milk is an excellent source of vitamin A. Professor Sherman, of Columbia University, one of the outstanding diet specialists of the world, has stated, as a result of his own extensive research, that "milk is the most important of all foods as a source of vitamin A." The same author has stated, in his book on "Chemistry of Food and Nutrition": "Of the three vitamins A, B, and C, vitamin A is the factor of greatest practical importance to nutrition and health, because so many of our staple foods are poor in vitamin A, and because a dietary poor in this vitamin causes such wide-spread weakening of the body and increases its susceptibility to so many infectious diseases."

In the January 1932 issue of the American Journal of Public Health, the work of Professor Mellonby and his wife on vitamin A (British Medical Journal, Oct. 3, 1931) was discussed. As a result of their work with 550 pregnant women, these authors reported a significant reduction in morbidity following the administration of a preparation containing vitamins A and D; and the authors conclude, on the experimental evidence, that the vitamin-D fraction had little to do with the results.

Again, Professor Mellonby and his wife have for some 5 years taken cod-liver oil (a rich source of vitamin A) daily and report that during this time they have been practically free from ordinary colds. This latter, as the editor of the Journal says, is of course not a controlled experiment; but the work on pregnant women was controlled, as 275 of the

women received the vitamin A preparation and the remaining 275 did not. These statements are very interesting in view of the widespread feeling that vitamin A gives protection against infection.

Milk seems also to be a good source of vitamin G. This vitamin, as the result of the renowned work of the late Surg. Joseph Goldberger, of the Public Health Service, has been found to be valuable both in preventing and in curing pellagra, a dietary deficiency disease. Since milk contains vitamin G, the consumption of milk has been stressed by Goldberger and others as one important measure for combating pellagra.

Finally, milk is one of the most digestible of foods. It is easily digested by most persons. Sherman states that the coefficient of digestibility of milk protein is from 97 to 98 percent.

It may be asked why milk was called the most nearly perfect food rather than "the perfect food." This is because, while it is the most nearly perfect food, it is not absolutely perfect, and what has been said would not be complete without reference to its shortcomings. Milk does not seem to be an entirely dependable source of the other vitamins, nor does it contain sufficient iron, and experiments have shown that infants and young animals restricted entirely to milk over considerable periods of time develop anemia.

For this reason, and also because variety in the diet stimulates the appetite, we should not try to live on milk alone. The diet of normal children should include a quart of milk daily, supplemented with a wise selection of other foods, among which should be included orange juice, cod-liver oil, and green vegetables. Normal adults may wisely include at least a pint of milk in their daily diet. Of course, abnormal adults or children should receive and follow competent medical advice.

It seems reasonable to believe that in the future public-health officials will not always grade milk on the basis of its cleanliness and safety alone, but will also grade it with reference to its nutritive value. Recently it has become quite apparent that the kind of feed a cow gets very much affects the nutritive value of the milk she gives. Therefore it may be anticipated that some time in the future grade A milk may be required to have been produced by cows which receive at least a standard balanced ration so that their milk may possess the maximum food value for human beings.

(2) HOW CAN MILK BE SAFEGUARDED TO PREVENT IT FROM TRANSMITTING DISEASE?

It seems a pity that milk can be such an excellent food and at the same time so dangerous if not properly safeguarded. But it is unfortunately true that milk is not only a good food for human beings, but also a good food for certain types of disease organisms, such as those causing typhoid fever and diphtheria. Then, again, milk may sometimes, without our

knowledge, come from sick cows. In such cases their milk may at the time of milking contain large numbers of the organisms of such diseases as septic sore throat, undulant fever, and tuberculosis.

Occasionally there occur milk-borne outbreaks of appalling magnitude. Only a few years ago a milk-borne outbreak in Montreal caused over 5,100 persons to be stricken with typhoid fever, and killed over 500 of them. Fortunately most disease outbreaks caused by unsafe milk are not nearly so serious as the Montreal outbreak, but the United States Public Health Service receives reports each year of from 30 to 50 outbreaks.

This fact is tremendously significant to all of us who drink milk--AND ESPECIALLY TO ALL OF US WHO HAVE CHILDREN.

Among the diseases which may be transmitted through milk are tuberculosis, typhoid fever, scarlet fever, diphtheria, septic sore throat, and undulant fever. Let us confine ourselves for the moment to but three of them--tuberculosis, typhoid fever, and septic sore throat.

SUPPOSE YOU WERE A DAIRYMAN. WHAT WOULD YOU DO, SHORT OF PASTEURIZATION, TO MAKE SURE THAT NONE OF YOUR CUSTOMERS WOULD EVER CONTRACT ANY OF THESE DISEASES BY DRINKING YOUR MILK?

Well, in the case of tuberculosis, almost the only thing you could do would be to have your cows tested for tuberculosis and kill those that showed they had it.

Suppose you did that. Suppose you had a herd of 50 splendid, pure-bred cattle, that you had them all tested, found 3 or 4 of them to be tuberculous, had these 3 or 4 slaughtered, and then continued with your business. Would you have protected your customers from contracting bovine tuberculosis? If I were one of your customers, could you give me real assurance that I would never regret having permitted my children to drink the milk from your dairy?

Certainly the four you had slaughtered would no longer be a menace. But suppose that a year later, when you came to test again, you found another cow to be tuberculous. Then you would face a very serious question. You would wonder how many months it had been tuberculous. You would be assailed by the disturbing thought that perhaps some innocent child had received through your milk supply the germs of tuberculosis, an infection which might not disclose itself until considerable time had elapsed, until, perhaps, the child and the parents had forgotten that you had ever been their dairyman.

Do not let anyone benumb your conscience into believing that this does not happen. It does happen, again and again, even at certified and grade A raw-milk dairies,

and slaughtering the infected cows does not undo the damage they have already done.

Now let us pass on to typhoid fever. If you were the owner of a raw-milk dairy, what would be the most effective thing you could do, short of pasteurization, to make sure that your milk supply would not carry typhoid fever to your customers?

Of course, if one of your milkers or other helpers contracted typhoid fever, you would at once have him quarantined or sent to a hospital; and if you were prompt and careful, there would probably be very little danger. But, unfortunately, that is not usually the way epidemics of typhoid fever are caused by milk. When milk becomes infected with typhoid fever it is usually not a sick person who is at fault, but, instead, a perfectly well individual, one who had had typhoid fever perhaps years ago and who possibly did not even know that what he had was typhoid fever. Nevertheless, he has, as a result of this possibly unrecognized sickness, become what is known as a typhoid carrier. Such a man is, so far as we know, a perfectly well individual. He doesn't look sick and he doesn't feel sick. But, unfortunately, he still carries typhoid fever germs, either in his gall bladder or elsewhere, from which they are discharged with his feces or urine, and thus accidentally now and then find their way to his hands, his clothing, and eventually to the dairy equipment and to the milk supply.

Of course, the typhoid-fever carrier is not aware of his condition. If he were, he would, in most cases, be honest enough to refuse to imperil the lives of his fellow beings by continuing to work at a dairy. But that is the dangerous thing about it. The typhoid carrier is usually ignorant of the fact that he is a menace, a carrier of disease and death.

Knowing these facts, then, what would you do if you were the owner of a raw-milk dairy? Possibly you would do what is required by the Public Health Service milk ordinance for grade A raw-milk employees who have at any previous time had typhoid fever. You would have everyone at your dairy send samples of their feces and urine to the health department laboratory so that it could be determined whether they contained any typhoid organisms. Fortunately scientists have discovered an excellent method of recognizing typhoid fever germs.

Now suppose you took this precaution and the laboratory reported that so far as it could determine none of the specimens of feces or urine contained the germs of typhoid fever. Could you then rest assured that none of your employees is a typhoid-fever carrier, and that none of your customers would ever contract typhoid fever from the milk you sold them?

Unfortunately, the answer must be no. Many typhoid-fever carriers do not discharge the typhoid-fever germs every day, and on the day the specimens were collected and sent to the laboratory the carrier, if there had been one at your dairy, may or may not have been discharging the organisms. If he was

discharging them, the chance that the laboratory would find them is excellent; but if he was not discharging them the laboratory could not, of course, find them.

There is, therefore, no way to make absolutely sure that raw milk will never contain the germs of typhoid fever; and if you knew as much about the danger as the health officer does, you, as a dairyman, would live constantly in fear lest some morning you awaken to find the newspapers pointing the finger of accusation at you and your milk supply.

We have now discussed 2 of the 3 diseases we intended to discuss.

How about the third--septic sore throat? What could you, if you were a producer of high-grade raw milk, do to prevent the transmission of this disease through your milk supply to your customers?

Frankly, I do not know. A milker may think he has an ordinary cold, when really it is septic sore throat. He may then infect the milk supply directly, or he may infect a cow's udder during the milking process, and the milk from that cow may later be simply teeming with the organisms of the disease.

Suppose we were to examine every milkor's throat every day and every cow's udder every day. Even then we would not have done away with the danger, because by the time the report came back from the laboratory some of the milk would have been consumed. Of course, I need not tell you that a daily examination would be out of the question, if for no other reason than the expense entailed.

A septic sore throat outbreak can be very serious. In Portland, Oreg., several years ago, a milker infected a cow's udder; and before the resulting epidemic was quelled, 487 persons sickened and 22 died.

To repeat, I do not know of any way in which you could guarantee that septic sore throat would not be spread through your raw-milk supply.

IT SEEMS IMPOSSIBLE, THEN, TO ESCAPE THE CONCLUSION THAT ALL MILK SHOULD BE EITHER PASTEURIZED OR BOILED TO MAKE IT SAFE.

Should we rely upon boiling? That is what is done in many parts of Europe and South America, and, as a result, they have in those places practically no milk-borne disease. But with these people boiling milk is a matter of daily habit. In most of the areas in question, the housewife does not have ice, and milk is boiled to keep it from souring.

In this country we have to deal with two factors: First, that most families do have ice or electric refrigerators and can keep milk sweet; and second, that many people do not like the taste of boiled milk.

If health officers simply said to all of the people, "Boil your milk," they could not depend upon a sufficient number doing it to prevent epidemics. Again, the adults and children who now drink raw milk because they like its flavor would not drink so much milk if it had to be boiled, and we must, by all means, encourage people to drink enough milk. It is just as important to do this as it is to make milk safe.

There is, then, only one other thing we can do (short of putting chemicals into the milk, and nobody wants to do that), and that is to pasteurize the milk. That is why most health authorities today feel that ALL milk should be pasteurized. The most common method of pasteurizing milk commercially is to heat it to 143 degrees F. and hold it at that temperature for 30 minutes. This treatment kills or renders harmless all disease organisms which may be transmitted through milk. Higher temperatures for shorter periods are also effective.

You need not be worried about the effect of heating milk upon its food value. The vast majority of health officers and physicians today believe that pasteurizing milk has no significant effect upon its food value, especially when it is remembered that all children should receive a supplementary diet in addition to milk. Vitamin C is affected by heat, but this is not significant, since the amount of this vitamin present even in raw milk is frequently insufficient, and it is therefore necessary to feed children orange or tomato juice or some other high-bearing source of vitamin C, regardless of whether the milk they drink is raw or pasteurized. Therefore, since the child will get all the vitamin C it needs anyway, why take a chance on disease by insisting upon giving it raw milk?

Several years ago the Public Health Service conducted an intensive study of about 3,700 children to determine whether those who drank heated milk actually thrive less well than those who drank raw milk. The results of the studies showed that the average weight of the children receiving raw milk was 33.2 pounds, whereas the average weight of the children receiving heated milk was 33.6 pounds; also the average height of the children receiving raw milk was 37.4 inches, whereas the average height of the children receiving heated milk was 37.5 inches. Furthermore, from the parents' reports it was found that the children who drank raw milk suffered with communicable diseases more frequently than did the children who drank heated milk only. The final conclusion of the study was that, taking into account the average supplementary American child diet, children who are fed pasteurized or other heated milk thrive as well as children who are fed raw milk, and contract certain communicable diseases less frequently.

"But," you may say, "many people do not like the flavor of pasteurized milk, and I am one of them."

That may be quite true; but it is true only when a low-grade, unclear milk is used for pasteurization or when a high-grade milk is improperly pasteurized. Pasteurization will not remove the bad flavor from bad milk, and even good milk can

be damaged by pasteurizing it improperly. But if high-grade milk is properly pasteurized, there is no change in the flavor. To prove this, your health officer may conduct the following demonstration:

He should satisfy himself that the local pasteurization plants are strictly observing the grade A requirements and that there is no real flavor difference, such as might result from the use of a higher pasteurizing temperature than is required or from exposure of the milk to copper. Then one of the local pasteurization plants may furnish both raw and pasteurized milk in quart bottles to the Rotary and other civic luncheons, the bottles being marked with distinguishing marks unknown to the drinkers. Each member should be provided with six glasses, placed in a row in front of him. A small portion of pasteurized milk should be placed in 3 of the glasses and a small portion of raw milk in the other 3 in an order unknown to anyone but the health officer. The members should not be told how many glasses contain pasteurized milk. Then each member should be asked to tell by tasting which of the six glasses contain pasteurized milk. (It is fundamentally important that the raw and pasteurized milk be identically the same milk, except for the fact of pasteurization. This condition is accomplished best by obtaining the raw milk directly from the pasteurizer just prior to the pasteurization process, after thorough mixing, and then obtaining the pasteurized milk from the same batch of milk.)

Each guest should be provided with a small card. The glasses should be considered as being numbered from left to right and each guest should be asked to write on the card the numbers representing the glasses containing pasteurized milk. Then someone from the speaker's table should announce the true content of each of the six glasses, and all of the members who guess correctly may be awarded a prize of some sort.

If pasteurization really imparted an undesirable flavor to milk, most of the guests should give correct answers for all six glasses. If pasteurized milk really cannot be detected by flavor, most of the members should fail in reporting all six glasses correctly. In tabulating the answers, each guest who fails to report all six glasses correctly should be listed as "wrong." A very few may guess correctly just by chance. This chance is the same as that of throwing all 6 heads when pitching 6 pennies at a time, usually not more than 1 or 2 times in 100 throws ($p=0.0156$).

After this guessing contest has been tried upon at least 100 persons in the city, the results may be published in the newspapers as evidence of the fact that proper pasteurization really does not affect the flavor of milk.

Of course we should not rely upon pasteurization as a cure-all and neglect all precautions at the farm, even if the flavor problem did not exist. The pasteurization process is operated by human beings and therefore is not entirely

foolproof, though it is nearly so. We should firmly insist that the milk we drink be not only properly pastourized but also carefully produced, so that we will have the maximum practicable protection all along the line from the cow to the consumer.

(3) HOW CAN CONSUMERS BE CERTAIN THAT THE MILK THEY DRINK HAS BEEN THUS SAFEGUARDED?

As above stated, milk which has been properly safeguarded must have been both carefully produced and properly pastourized. Is the milk you buy such milk? The first thing you must know before you can be sure of this is whether the milk regulations in force in your city correctly proscribe the methods of production and pastourization. There has been much disagreement on this point among health officers in the past, and obviously not all health officers have been correct. In some cities the milk is not carefully produced before pastourization, and in others important pastourization principles are ignored or faulty pastourization machines used, and yet the milk may be sold as grade A or otherwise designated as safe.

To remedy this situation the Public Health Service has for a number of years been urging American States and cities to adopt one uniform system of effective control. The model uniform regulations are carefully reviewed annually by a National Advisory Board, composed of 16 experts in milk-control work.

Under the regulations approved by this board, grade A pastourized milk is milk which has been both carefully produced and properly pastourized and is as safe as any milk can be made. Grade A raw and certified milks are raw milks which are as safe as ANY RAW MILK can practicably be made. If you prefer to buy either of these raw grades, you can secure the added protection of pastourization at home as follows: Place the milk in an aluminum vessel on a hot flame and heat to 155 degrees F., stirring constantly; then immediately set the vessel in cold water and continue stirring until cool.

If you buy grade A pastourized milk, however, no additional home treatment is necessary.

Over 2,200 American communities have already put these uniform milk regulations into effect and are grading milk in accordance therewith. In such cities a milk distributor who is found to violate any grade A requirement is demoted or downgraded by the health officer, and must remove the grade A caps and substitute lower grade caps, depending upon the nature of the violation. This attracts your attention if your milk distributor becomes careless. Finally, the health officer may revoke the permit of such a distributor if he persists in failure to safeguard the milk he sells.

You may wish to know what you should do if your municipality has not as yet adopted these nationally recommended uniform milk regulations. The best thing to do is to call on your health officer and discuss the matter with him. In most cases he will appreciate that and welcome your assistance in

urging the city authorities to adopt the ordinance and provide the necessary inspectors.

However, your health officer may have already worked out a good milk ordinance of his own and he may be justly proud of the results he has accomplished. If he is in doubt as to whether the local ordinance is in all respects the equivalent of the United States Public Health Service ordinance, he may consult the State milk-control authority or the Public Health Service. Even if your local milk ordinance is a good one, however, your health officer and you may agree that there are advantages of economy and efficiency in the adoption of a standard. There is no profit in difference for difference's sake. Of course, if your local ordinance is really better than the nationally recommended standard, your city should not drop the improvements; but it should be made quite certain that they are real improvements. If so, they should be brought to the attention of the Public Health Service, which should incorporate them in its standard.

One final doubt may still assail you. You may want to know how you can be sure that the local milk inspectors do not give a dairy a grade A rating when it does not deserve it. This is a very real problem which is taken care of by another part of the general national milk sanitation program of the United States Public Health Service. It recommends that the State milk control authority in each State should periodically measure the excellence of the milk sanitation work done in each municipality in the State by means of a rating method devised by the Public Health Service, and award ratings. If the city milk-control work is found to rate 90 percent or more, the name of that city is included in a list published periodically by the Public Health Service. A copy of this list may be secured by addressing the Public Health Service. You and your fellow milk consumers should leave no stone unturned in helping your health officer qualify your city for inclusion in this list.

Last of all, the Public Health Service itself occasionally rates cities in the various States and thus standardizes the State rating work. This gives you the assurance that the ratings awarded by the State department are comparable with similar ratings in other States.

SUMMARY

(1) Milk is an excellent food because (a) it is a natural food, (b) it is a cheap source of energy, (c) it is a good muscle builder, (d) it is a good tooth and bone builder, (e) it is a highly concentrated food, (f) it is an excellent source of vitamins A and G, and (g) it is highly digestible.

Normal children should consume a quart of milk a day, normal adults a pint, together with a well-balanced supplementary diet, which in the case of children should include such foods as orange juice, cod-liver oil, and green

vegetables. Abnormal children or adults should receive and follow competent medical advice.

(2) Milk may be safeguarded so as to prevent it from transmitting such diseases as tuberculosis, typhoid fever, scarlet fever, diphtheria, septic sore throat, and undulant fever by careful production and proper pasteurization. Neither production precautions alone nor pasteurization alone are adequate. Both are necessary to assure the maximum protection from cow to consumer.

(3) Consumers may assure themselves that the milk they drink has been thus properly safeguarded by purchasing only grade A pasteurized milk as defined by the United States Public Health Service milk ordinance, or by pasteurizing at home certified or grade A raw milk as defined by this ordinance. Consumers should ascertain whether the local milk ordinance is equivalent to the uniform milk ordinance recommended by the Public Health Service, and if not, they should offer to assist the local health officer in having all of its provisions incorporated in the local milk ordinance, or, better still, in having the present ordinance repealed and the recommended uniform ordinance adopted outright.

To insure that the ordinance is strictly enforced, the local milk control work should be rated at least biennially by the State milk control authority, and the rating should be not less than 90 percent, based upon the standard rating method recommended by the Public Health Service. Cities with 90 percent ratings are listed semi-annually by the United States Public Health Service. Copies of the list and of the recommended uniform milk ordinance may be secured by addressing the Public Health Service at Washington.

A STUDY OF MILKBORNE EPIDEMICS

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EPIDEMIOLOGY

In the twenty-two year period 1917-1938 inclusive, New York State, recorded 151 milkborne outbreaks of sickness. New York City, with no raw milk other than a relatively small amount of certified milk, recorded none. Of the diseases involved, typhoid and paratyphoid fever contributed the largest number of outbreaks (75) but in two-thirds as many outbreaks of streptococcus infection--scarlet fever and septic sore throat--the total number of victims was nearly five times as great. The other diseases were diphtheria, poliomyelitis, bacillary dysentery, and gastroenteritis.

Sixty-nine of these outbreaks occurred during the last twelve years of the period, and a study of the data on these has revealed some interesting and significant facts. All excepting four occurred in rural towns and villages. The source of infection in eight was not determined but the other sixty-one originated at the farm. This illustrates the fallacy of the still popular idea that milk is safe if it comes directly from the farm to the consumer.

Direct contamination by cases or carriers on the farms appears to have been responsible for about half of the sixty-nine outbreaks, if we include a few in which the opportunity for such contamination was suspected but not proven. Responsible cases of mastitis were located in twenty-four other outbreaks of septic sore throat, scarlet fever, and gastroenteritis.

Considering as one group the thirty-nine outbreaks of scarlet fever and septic sore throat occurring in the twelve-year period, responsible cases of mastitis were discovered in eighteen. It is almost certain that some were missed, due to the investigators getting on the job too late and to reticence or actual concealment on the part of dairymen. In eleven of the eighteen, the probable human sources of infection of the cows' udders were located. We believe, of course, that there were human sources in the other seven. The conditions from which the eleven infected persons suffered were about evenly divided between throat and wound infections, the latter most often on the hands.

ADMINISTRATIVE QUESTIONS RAISED BY EPIDEMICS

Twenty-five of the more important outbreaks of which a majority were of scarlet fever and septic sore throat, were selected as the basis of an inquiry designed to find the answers to some questions of interest primarily from an administrative standpoint. This revealed, among other things, that in only five of sixteen outbreaks did physicians attending cases report

them promptly to the local health officers, as they are legally required to do. In only ten out of nineteen instances did local health officers report to the State Department of Health without serious delay. In many of the outbreaks of streptococcus infection in which bovine udders were infected by milkers having sore throat or discharging sores or wounds, the dairymen apparently know of the condition of the milkers before the bovine infection occurred. In connection with eighteen outbreaks, it was reported that dealers whose milk was responsible went out of business in eight instances, in three the dealers lost some of their trade, and in seven their business apparently was not affected. In one of the latter instances it was reported that gross negligence on the part of the dealer was responsible for the outbreak--one of our most serious.

Indeed, it is a regrettable fact that there is evidence in our files which forces us to the conclusions that ignorance of facts which should be common knowledge among intelligent dairymen and dealers, failure to conform to commonly recognized standards of practice in the milk business and to legal requirements, carelessness, or negligence--one or all have been factors in the causation of many if not most of our outbreaks.

Reference has been made to the after-effect, if any, on the business of dealers whose milk was responsible for eighteen epidemics. Through the cooperation of the secretary of the local Chamber of Commerce, we were able to get some interesting data on the effect of one of these on business in general. This was an epidemic of 511 cases of scarlet fever in a village with a population of 4742: about 1 in 9 of the population having been ill. A canvass was made of two manufacturing plants and sixteen other places of business. The estimated aggregate loss from falling off of business and the closing of one of the manufacturing plants was \$149,721. Considering that the canvass did not include all places of business and that no attempt was made to determine the cost of families of victims of the epidemic this figure would seem sufficiently impressive to convince business men, not otherwise convinced, of the importance of preventing such epidemics.

ILLUSTRATIVE OUTBREAK FROM STAPHYLOCOCCI

A brief reference to two outbreaks will illustrate the possibility of trouble from carelessness and disregard of legal requirements, and will bring out some other points. One was an outbreak of 75 cases of gastroenteritis in two associated private summer camps, one for boys, the other for girls. These camps received daily about 240 quarts of supposedly pasteurized milk, in cans, from a producer-dealer who also sold about 220 quarts daily to other customers. The cases in the two camps occurred, at different times on the same day, about five hours after consumption of milk. At the time of investigation some of this milk remained in one can and, when the phosphatase test was applied, gave a complete raw reaction. The laboratory reported both *Staphylococcus aureus* and hemolytic streptococci in samples from the can. At the dairy ten cows

were found to have mastitis. The usual practice was to cool the raw milk in a vat at the farm milkhouse and to store the cans of bulk pasteurized milk in a vat off the pasteurizing room. The investigation report indicated that the milk-house vat had been out of commission because of a leak; and all of the cans, unlabeled, were cooled in one vat, the raw milk at one end, pasteurized at the other. An employee at the plant agreed that on the day of the outbreak he may have gotten two cans of raw milk by mistake--as he apparently did. When I say the milk was cooled, I say it with reservations: the temperature of milk in the vat at one visit was 70 degrees F. Counts on two bottles of pasteurized milk from the plant were 150,000 and 360,000 colonies per ml. The sanitary code limit for the grade is 30,000.

This outbreak, presumably due to consumption of *Staphylococcus aureus* toxin, quite evidently was the result of inadequate supervision by the proprietor and of careless methods both at the farm and in the plant: milk from cows with mastitis being used, cans not properly labeled and separated, and inadequate cooling giving opportunity for pathogenic organisms to multiply and develop toxin. This producer-dealer is said to have lost considerable business and appears to have learned his lesson.

OUTBREAK OF TYPHOID FEVER

An outbreak of seven cases of typhoid fever in a small city demonstrates the weakness of control measures when we are dealing with unreliable individuals. The patients were Italian and Polish and their infection was traced to milk, supposedly pasteurized, from a Polish dealer. He served about 780 patrons daily. It developed that at the time when the infection presumably occurred, he was buying twelve to fifteen quarts of milk daily from a four-cow dairy on which there was a Polish woman, known and registered as a typhoid carrier under the supervision of the health officer of the township in which the farm was located. Previously, on the carrier agreeing to have no contact with milk or utensils, the dairyman had been authorized to send his milk to another city for pasteurization. Instead of this, it had gone, at least for a time, to the local dealer. Both the dairyman and dealer denied this until confronted with proof. The carrier had been washing utensils on the farm. The dealer was reported finally to have admitted that, on some occasion when he ran short of pasteurized milk, he might have bottled this raw milk. This presumably was what happened. The dealer paid a penalty of fifty dollars. The dairyman was forbidden to keep cows on the farm as long as the carrier remained and eventually sold out.

While we have had a few milkborne outbreaks traceable to known typhoid carriers, the unrecognized carrier naturally is a greater source of danger when milk is not pasteurized. An outbreak of thirteen cases of typhoid fever a year ago in a small village illustrates what may happen. A small raw milk producer-dealer needed more milk and without authorization from the health officer, got fifty quarts daily from a relative's

farm which was conveniently located. The cases began developing shortly after this milk was added. The relative turned out to be a typhoid carrier who had had typhoid fever eighteen years before. For several years his milk had been going to a city pasteurizing plant and nothing had happened.

In this outbreak it was the people who used the most milk, generally speaking, who became infected. Among 141 who used the milk and were not infected, the average amount consumed daily per person was 0.98 pint. The average among those who contracted the disease was 2.2 pints daily. This outbreak also illustrates the point that the extent of an outbreak is not the only measure of its seriousness. Among the thirteen victims there were three deaths (a fatality rate of 23 percent): a girl of thirteen, a boy of eighteen and a man of seventy-three. The latter's wife also had the disease but survived.

OUTBREAK OF SEPTIC SORE THROAT

An outbreak of 33 cases of septic sore throat in a small village had some interesting features. This was an explosive outbreak limited to employees of a milk collecting plant, their families, and a few intimate friends. The plant was shipping raw milk to a large city for pasteurization. The employees were permitted to take milk from the plant, in their own containers, for family use. Ordinarily this milk was drawn from the cooler into a can at about the same time each day and later was measured into the employees' pails. This milk was the one thing in common among the plant employees and there had been no previous illness among them. Milk came to this plant from 199 herds, representing about 3600 cows. Trying to find the ultimate source of infection seemed like "looking for a needle in a haystack". Nevertheless, one of our optimistic milk sanitarians began making Brood smears of milk from each dairy, as it arrived at the plant. "Lady Luck" was on his side: he had examined only a few smears when he found one in which there were large numbers of streptococci and leucocytes. A "Brood smear" of a similar sample is shown in Figure 1. A visit to this farm revealed a cow with mastitis, from whose milk hemolytic streptococci of Lancefield's Group A were later isolated. The milk from this farm usually reached the plant at about the time the employees' supply was being taken out.

Further investigation revealed the probable source of infection of the cow's udder. She had come from another farm. Late in December (the epidemic was in April) the man who milked her had "a severe sore throat" as his mother also did. Later in the winter, the cow freshened and developed what was described as a severe "caked udder". At the time of the epidemic, this man still had hemolytic streptococci in his throat and there is little doubt but that he was the ultimate source of the epidemic. And here let me repeat what can not be repeated too often: the only cases of mastitis responsible for septic sore throat or scarlet fever, so far as we know, are those arising from infection with hemolytic streptococci from a human source.

Three of the four outbreaks thus far mentioned were from milk intended to be pasteurized before being used. This observation, plus the fact that in New York State in at least fifteen years we have discovered no outbreaks from milk even partially pasteurized, gives us some idea as to what even imperfect pasteurization saves us from. It suggests, also, that failure to pasteurize (the "human element") is, in general, a much greater source of danger than defective pasteurizing apparatus. It does not minimize the importance of efficient apparatus but it supports the belief that there is a considerable margin of safety in the standard procedures.

ASSOCIATED OUTBREAKS OF SCARLET FEVER AND SEPTIC SORE THROAT

Now, in order to bring out some special points, I want to make brief references to two associated small outbreaks of scarlet fever and two much larger ones of septic sore throat.

The two scarlet fever outbreaks; one of sixteen cases, the other of nine, although they occurred in different counties eight months apart, were traced to the infected udder of one cow--or, to go back a little further, to a milker who, several weeks before the first outbreak, had what was evidently milk scarlet fever. At the time of this first outbreak the cow was found to have mastitis; and Beta-hemolytic streptococci of Lancefield's group A, corresponding to those on patient cultures, were isolated. The cow "dried off" and, due to an unfortunate combination of circumstances, instead of being slaughtered, was sold, changed hands several times, and eight months after the first outbreak, arrived on a farm in an adjoining county. There she freshened, her mastitis recurred, and the second outbreak followed. Nine persons, all members of the families of the proprietor and hired man, used the milk, and all developed scarlet fever. The same organisms were again isolated from the milk. The photomicrographs shown in Figure 2 (for which I am indebted to Dr. J. I. Schleifstein of our laboratory staff) are unique: the first ever made and published of sections of an udder responsible for two scarlet fever outbreaks eight months apart--with the streptococci appearing "in person."

The winter before last we had an outbreak of 375 cases of septic sore throat in a village of 1900: one-fifth of the population affected. It is a coincidence that the producer-dealer whose raw milk was responsible sold approximately one-fifth of the village supply. The only other circumstances I want to mention are that seventeen of the 375 patients were said to have had typical scarlet fever and another seventeen to have "pooled", while one patient had erysipelas.

In an epidemic of 500 cases of septic sore throat in a good-sized village (about one in eight of the population affected), there were six cases of erysipelas: two with erysipelas alone and four with erysipelas complicating throat infections. No typical scarlet fever cases were seen but several patients had atypical rash. The responsible cow had a teat injury; an unsterilized teat dilator was used and acute mastitis followed.

ASSOCIATED ETIOLOGY OF SCARLET FEVER, SEPTIC SORE THROAT, AND ERYSIPELAS

I am referring to the clinical features, particularly, in these two epidemics because the study of milkborne epidemics of scarlet fever and septic sore throat has helped to throw new light on the subject of beta-hemolytic streptococcus infection in general. The idea has prevailed for many years that scarlet fever, septic sore throat, and erysipelas were separate and distinct diseases, incited by different types or strains of organisms. However, in our epidemics it has been repeatedly observed that when a cow's udder is infected by one individual who may have either scarlet fever, sore throat alone, or a wound infection, the ensuing epidemic produces cases with and without scarlatinal rash (apparently the only distinction between scarlet fever and septic sore throat) as well as cases of erysipelas. When all of these conditions can be incited, as quite evidently they are, by the same organism, it seems equally obvious that they are simply different manifestations of the same infection. Apparently, if the infection is inoculated into the skin of a susceptible individual, erysipelas results. If the infection passes through the usual oral channel, the reaction seems to depend partly on the toxin-producing power of the organism and partly on the susceptibility of the patient. If the original infection came from a case of so-called scarlet fever, it appears that the susceptible recipients develop scarlet fever if they have not had it or been artificially immunized against it; otherwise they have what we have been calling septic sore throat. If the original source were a case of septic sore throat, it would appear that only those patients who are especially susceptible would react to the small amount of rash-producing toxin by developing a scarlatiniform rash as well as the throat and other symptoms. Perhaps if I were more of a scientist, I should be more cautious about expounding these still theoretical explanations--but there they are for whatever they are worth.

CLASSIFICATION OF INCITANT STREPTOCOCCI

Finally, having ventured so far, I am going to venture a little further and say something about classification of streptococci, this time with the reservation that I am not a bacteriologist and can give only my understanding of the facts. The changes from old to new terms and classifications are confusing. If my attempt at explanation does not clarify, I trust it at least will not add to the confusion because it is quite necessary to get some of these things straight if we are to understand the relationship between bovine and human streptococcal infections.

The latest and most generally accepted classification into Alpha, Beta, and Gamma streptococci is based on the reactions produced by the organisms when incubated on blood-agar plates. The Alpha group, which includes what we have called *Streptococcus viridans*, produce a brown discoloration and only slight or incomplete hemolysis (dissolving of

red blood cells) around the colonies. Those of the Beta group produce clear, colorless zones of hemolysis, and so are spoken of as Beta-hemolytic streptococci. This is the group that concerns us here. Those of the Gamma group produce no hemolysis.

Lancefield, on the basis of serological tests, has subdivided the Beta-hemolytic streptococci into nine sub-groups, which she has designated as A, B, C, D, E, F, G, H and K. This is called Lancefield's classification and appears to have been quite generally accepted.

Group B probably corresponds roughly to the old agalactae or Streptococcus mastitidis grouping, because it is those of this group which are the chief cause of bovine mastitis. However, it is Group A which concerns us in this discussion because it consists almost wholly of Beta-hemolytic streptococci of human origin and includes the incitants of so-called scarlet fever, septic sore throat, and erysipelas, as well as serious wound infections. They are also highly infective for the bovine udder when there are breaks in the protective tissues through which they can enter. This explains the risk which dairymen take when they allow persons with sore throats and wound infections to milk their cows.

SUMMARY

So there are some very practical conclusions which can be drawn from such a study as this of milkborne epidemics. Such epidemics occasion serious inconvenience and financial loss as well as danger to life and health. Theoretically they are preventable by strict compliance with health regulations and intelligent and conscientious application of satisfactory trade practices and hygienic principles which should be a matter of common knowledge among ordinarily well-informed people. Viewing the matter practically, however, not all people in the milk business are intelligent and honest, any more than are all people in any other line and not all intelligent and honest people are well-informed concerning hygienic principles. Generally speaking, therefore, the "human element" can not be trusted. Our hope of protection from milkborne infection, to repeat what is becoming an axiom and again speaking generally, lies in pasteurization.

A SCARLET FEVER OUTBREAK DUE TO RAW MILK

By Roy F. Feemster, M.D., Dr. P.H., and
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As long as we have milk supplies unprotected by pasteurization, we shall continue to have outbreaks of disease carried by milk. Fortunately over 85 per cent of the milk of Massachusetts is pasteurized and outbreaks are limited to fewer and fewer cases since no large supplies are now unprotected. During the last five years there have been 16 known outbreaks of milk-borne disease in Massachusetts, and in not a single instance has a milk supply of over 300 quarts been involved. This report deals with another epidemic on a small raw milk route.

ESTABLISHING THE PRESENCE OF AN EPIDEMIC

It took very little investigation to establish the fact that there was a milk-borne outbreak at the time our attention was called to the situation. Between February 1 and April 15, 1933, a period of ten weeks, there had been only 13 reported cases of scarlet fever in East Bridgewater (population 3,591). At the beginning of the investigation on April 24, 21 cases had already been reported since April 15. Forty-one cases eventually occurred in the two weeks April 15 to April 30 (see Table I). The distribution of the cases among the milk dealers clearly pointed to the one milk supply (Dealer E) already under suspicion, as shown in Table II. Furthermore, the cases were scattered all over the town and there was no possibility that they could have been contact cases for some lived three or four miles apart, and there had been no social function or other meeting which all had attended, and the milk supply was the only factor in common.

In West Bridgewater (population 3,206) the earliest cases reported were in the families of the two regular customers of two stores supplied by Dealer E and the later cases among families who bought only occasional quarts at the same stores. Here again the cases could not be accounted for by contact, as the families were scattered. No cases of scarlet fever were reported in the period February 1 to April 15 (See Table I). Twenty-one cases occurred between April 15 and April 30, all of them except one being in families who used milk from the East Bridgewater dealer.

Another fact which pointed to a milk-borne outbreak was that several members of a family became ill practically simultaneously, those who did not show clinical scarlet fever having severe sore throats resembling the clinical picture of septic sore throat. One incident further supported the suspicion of the milk supply. Three children from Boston visited their grandparents in East Bridgewater and drank the milk for two days. The next day after returning home, two of them were ill with

TABLE I
Scarlet Fever Cases Reported by East Bridgewater
and West Bridgewater February 1-May 13

Week Ending	Number of Cases Reported	
	East Bridgewater	West Bridgewater
Feb. 4	1	0
" 11	0	0
" 18	0	0
" 25	0	0
Mar. 4	1	0
" 11	0	0
" 18	2	0
" 25	1	0
Apr. 1	2	0
" 8	3	0
" 15	4	0
" 22	23	9
" 29	14	12
May 6	2	0
" 13	3	0

TABLE II
Distribution of Cases Among Milk Dealers
of East Bridgewater

Dealer	Quarts deliv- ered daily	Cases of Scarlet Fever	
		April 15	April 30
A	300	2	0.6
B	200	0	0
C	150	0	0
D	100	0	0
E	75	35	47.
F	50	0	0
G	30	0	0
H	20	1	5.
Private supply	—	2	—

scarlet fever and were sent to the Boston City Hospital contagious disease ward.

Another interesting epidemiological fact was that in each of four families where cases of scarlet fever occurred an infant was being given either pasteurized or boiled milk and consequently escaped the initial infection. In two of the families the infant later developed a secondary case of scarlet fever from contact with earlier cases in the home.

The chronological occurrence of the cases is shown in Table III. The fact that the cases continued to be reported almost daily over a period of two weeks would seem to indicate that the milk carried the causative organism practically continuously for a considerable length of time. Such a condition points strongly to an infected udder in the dairy herd for it is difficult to believe that a carrier or a case could keep the milk so consistently and so heavily

contaminated. There is a bunching of the cases somewhat into three groups around the dates of April 18, 20 and 24, which

TABLE III
Chronological Occurrence of Infections Among
Users of the Suspected Milk Supply

		Scarlet Fever		Sore Throat	Total
		Primary Cases	Secondary Cases		
April	15	3	—	1	4
"	16	4	—	—	4
"	17	5	—	6	11
"	18	4	—	11	15
"	19	1	—	5	6
"	20	7	—	3	10
"	21	4	—	—	4
"	22	4	—	2	6
"	23	2	1	1	4
"	24	8	1	7	16
"	25	5	1	1	7
"	26	1	1	—	2
"	27	1	—	1	2
"	28	1	1	—	2
"	29	—	1	—	1
"	30	—	1	—	1
Totals		50	7	38	95

suggests that the milk may have been more heavily contaminated two or three days before each of these dates. This concentration at particular dates was not limited to cases of primary scarlet fever. The cases of sore throat among other members of the family displayed the same characteristic grouping (Table III). Some of the 7 cases classed as secondary may have been primary, due to drinking the milk at a later time, but when more than three days elapsed between the first and succeeding case in a family, the latter was classed as secondary.

THE SOURCE OF THE INFECTING ORGANISMS

It was impossible to determine the exact source of the epidemic. The milk dealer would not admit that there had been any suspicious illness in his family during the weeks preceding the outbreak and nothing could be found on physical examination to lead to such a suspicion. Throat cultures of the family disclosed that five of the ten were carrying hemolytic streptococci but they may have picked them up from the milk, which they used in considerable quantity themselves, as eight days had already elapsed since the first case occurred. It happened that the two who handled the milk did not have streptococci in their throats.

As mentioned above, the distribution of the cases pointed to an infected udder. The herd was examined on the first day of the investigation and two cows were found to have mastitis, one of recent origin and one of long standing with atrophy. In each instance the infection was limited to a single

quarter. Milk obtained from the cow with the more acute infection did not show hemolytic streptococci but showed numerous other bacteria. No milk was obtainable from the atrophied quarter of the other cow, only a small quantity of inflammatory exudate being forced out through a milk tube. This material showed hemolytic streptococci. Milk from the other three quarters of the two cows as well as from all the other cows in the herd did not show hemolytic streptococci. The dealer was using the milk from the three good quarters of the two cows but assured us that none from the affected quarters had been used. The herd was reexamined five weeks after the outbreak. The cows were found in good condition and no other udder infections had occurred in the meanwhile. Samples of milk were obtained from all the cows and found to be free from hemolytic streptococci.

Since no suspicious illness had apparently occurred on the milk farm, sources from which the organisms might have been imported were looked for. It was found that there had been an illness in the home of one of the dealer's customers that was quite likely scarlet fever. The onset was April 6. There was also a definite case on his milk route with an onset on April 11. Whether the streptococci might have been imported into the dairy from one of these cases will never be known and is probably less likely than that it came from the throat of one of the milkers.

THE INCUBATION PERIOD

Because some of the families bought most of their milk from other sources and only an occasional quart from the infected supply, the incubation period can be fairly accurately estimated in a few instances, where the infection was definitely due to a particular quart of milk. Table IV shows the date on which the milk was used and the dates of onset of the cases of scarlet fever or sore throat in six families. In two instances a small child was ill by the end of 24 hours. Forty-eight hours was the most frequent time elapsing between using the milk and the appearance of the first symptoms; in 11 of the 15 cases the period was this length or less. In one instance the exact number of hours could be determined. The milk was used late Sunday night (April 23) and before Tuesday noon all three of the family were ill and two were in bed. The father had a severe sore throat with recrudescences over a period of ten days. The child had a definite case of scarlet fever; the mother suffered only a moderately severe sore throat.

TABLE IV

Estimation of Incubation Period

Date on which milk was used	Dates of Onset	Remarks
April 17	April 18, 19	Infant ill first, sore throats.
" 19	" 21, 21	Both scarlet fever.
" 20	" 22	Scarlet fever.
" 22	" 24, 25	Both scarlet fever.
" 23	" 25, 25, 25	1 scarlet, 2 sore throat.
" 23	" 24, 25, 26, 27	Youngest child first, all scarlet fever.

THE CLINICAL PICTURE

The illness caused by drinking the milk varied all the way from easily diagnosed scarlet fever, with a characteristic rash, throat, tongue, fever and prostration, desquamation, and subsequent otitis or adenitis, through the various milder forms, in which some of the usual features were missing, to the other extreme where there was only a sore throat of varying degree, and in one or two instances even the sore throat was so mild that it might have been overlooked had not the cervical glands become enlarged and painful.

In a few cases the sore throat was very severe. There was marked prostration, high fever, edema of the larynx sufficient to interfere markedly with breathing, and in two cases a pharyngeal abscess developed.

One case, a man of 26, developed broncho-pneumonia and streptococcic septicemia and died within a day or two after admission to a contagious disease hospital. This was the only fatality.

THE INCIDENCE OF CASES AMONG USERS OF MILK

A visit was made into practically every household where the milk was delivered regularly and information obtained as to illnesses which had occurred since the beginning of the outbreak. In these households there were 167 individuals. Of these 19 claimed not to have used the milk raw, leaving 148 who did use the raw milk. Fifty-seven cases of scarlet fever and thirty-eight cases of sore throat occurred among these individuals, which gives a total of 95 infections of some kind. In other words, 64 per cent of those who were known to have used the milk became ill (see Table V). Every individual who had used the milk could not be reached because there were some who had bought only an occasional quart at the stores and the proprietors had kept no record of those who had purchased some of the infected supply.

Further study of the table brings out some other interesting points. As would have been expected, the highest attack rate for scarlet fever was in the lower age groups and the rate became progressively lower with increase in age. The concomitant sore throat in other members of the families did not show any such relationship to age, but there was a tendency for the highest rates to occur in the older age groups. The highest rate was among those over 25 and the lowest among those 5 to 9.

It is also noteworthy that 95% of the children under 5 years who used the milk became ill and that the attack rate for total infections progressively decreased with age.

TABLE V
Attack Rate Among Users of Infected Milk.
East and West Bridgewater

Ages	No. of persons in households	No. who used milk	Number of Cases			Attack Rates		
			Scarlet Fever	Sore Throat	Total Infections	Scarlet Fever	Sore Throat	Total Infections
0-4	24	20	15	4	19	75.0	20.0	95.0
5-9	14	14	9	2	11	64.2	14.3	78.6
10-14	19	19	10	5	15	52.6	26.3	79.1
15-19	15	15	5	5	10	33.3	33.3	66.7
20-24	16	16	6	3	9	37.5	18.7	56.2
25 and over	79	64	12	19	31	18.8	29.7	48.4
Total	167	148	57	38	95	38.5	25.6	64.2

There were 13 individuals among the 148 who used the milk who gave a definite history of having had scarlet fever. However, it was not felt that the history of previous scarlet fever was known or remembered accurately enough to make it justifiable to modify the tables with these 13 cases when undoubtedly a number of others in the 148 must likewise have had scarlet fever in the past. If Table V could have shown the attack rate among the actual susceptibles, as determined by the Dick test or other accurate measure of immunity, the rates would have been even higher.

CONTROL MEASURE INSTITUTED

The milk dealer was immediately ordered by the local boards of health concerned not to deliver any more milk which (1) included milk from the cows under suspicion, and which (2) was not pasteurized. Because the epidemic had disrupted his retail trade, he decided to give up his route and dispose of his milk to a dealer in a nearby city who sold only pasteurized milk. Likewise he was convinced that it would be economically expedient to butcher the two cows under suspicion. After slaughter, hemolytic streptococci were recovered from the udder of the one cow whose milk had earlier contained the organisms.

SUMMARY

An outbreak of 57 cases of scarlet fever and 38 cases of sore throat occurred on a milk route of only about 75 quarts delivered daily.

The consistent and heavy infection of the milk, as evidenced by the chronological occurrence of the cases, points strongly to udder infection in the herd. Hemolytic streptococci were found in the udder of one cow.

Ninety-five per cent of the children under 5 and sixty-four per cent of persons of all ages who used the milk had either scarlet fever or sore throat.

In 11 cases out of 15 in which it could be estimated, the incubation period was 48 hours or less.

Four infants who were being given pasteurized or boiled milk did not become ill when the initial cases occurred in the family. Two developed contact cases of scarlet fever later.

The occurrence of secondary cases due to contact in the families affected emphasizes that the total effect of such an outbreak is not over with the first generation of cases.

Again we have an outbreak of milk-borne disease spread by raw milk through a small route. With about 85 per cent of our milk pasteurized, it is the small raw routes that are the potential menace.

EXPERIENCE WITH AN EPIDEMIC

(Reprinted by permission from The Rural New Yorker
of December 13, 1930, page 1355.)

As a dairyman I make this report for the general good. I have a good herd, my plant and my bacterial counts have been consistently low. One of my cows cut a teat on a barbed wire fence. I sewed it up. It healed promptly. After the cut had healed the milk was put in and shipped with the rest. Nearly two weeks after the accident two calves got out of their pen and nursed her dry, probably injuring the tender tissue of the now healing. The next day when we put the milker on there was a hole in the teat and the milk leaked out. We fed her milk to the calves for a few days and then turned her out to pasture.

Just before the teat was torn open the second time, two of my men and I had sore throats. The doctor said one of the men had tonsillitis. The other man went to another doctor and his case was called a bad pair of tonsils. Neither doctor, so far as I know, said anything about not milking. Then it was reported that a number of people in town were sick with sore throat and were saying that milk was the cause, but the thought that my milk had anything to do with it never occurred to me. However, an extensive epidemic of sore throat followed with several deaths. On checking up on the case, the Board of Health found that the people affected had used milk from one or the other of the dealers who got my milk. This was their first clue.

A veterinarian examined my cows, and took separate samples of milk. Some of the cows had had slight garget trouble. The health authorities found nothing. However, my milk was considered the source of the trouble and shipment was stopped about eight or nine days after I had stopped milking the cow with the injured teat. Then the State Health Department took samples from all the cows in the barn including two that were just drying off. These showed nothing. The health officials still insisted that there must have been a cow responsible for the epidemic and that they ought to find her. They took cultures from each of our throats and I got my first introduction to the germ called Hemolytic streptococcus. How to spell the name is one of the things I learned, but the "bug" was worse than the name. The three of us were found to have the germs in our throats.

After the epidemic was over, a health department doctor showed me a chart of the epidemic. It indicated that most of the patients had taken sick within two or three days of each other (what he called the "peak" of the epidemic) and then the cases began to fall off rapidly until there were no more. After he left, I got to thinking about the "peak". The cases had already began to drop off before my milk was stopped. This looked funny. They told me that it took anywhere from a few days to two weeks for the disease to develop after a person got the germ. This they called the "incubation period". It then occurred to me that just a few days before the cases began

to fall off, I had stopp'd milking the cow with the injured teat. Previously I had not thought of her so I got her in, boiled a bottle, took a sample and delivered it to the State laboratory. They said it looked "suspicious". Something was wrong with the sample, and they did not get the "bug". They sent me sterile bottles and at their request I got a sample of milk from each quarter. This I did and from the samples they found the "strep" which they were looking for. They found it in one of the uninjured quarters and not in the injured one where the trouble must have started. The doctor told me this sometimes happens. The trouble will clear up in the originally affected quarter and work into another quarter. Then two State doctors including the Deputy Commissioner of Health came and took more samples and cultures. These checked out correct with the samples I had taken and it was definitely established that this cow was the medium that had contaminated my milk. It was a relief to find the mystery cleared up.

The doctors say that one of us must have had the germ first and infected the cow in milking. If so, it must have occurred a short time before the epidemic started. When I stopp'd milking her the epidemic stopp'd. It is clear now, but it certainly was a mystery at the time.

My experience has its lesson and it helps reveal our responsibility as dairymen to ourselves individually and collectively as well as to the public. If a cow has an injured teat or udder, her milk should not be used for human consumption until a laboratory test has shown it to be safe. I have always believed that milk from a cow with even a mild case of mastitis should not be used until a laboratory test has been made. If nothing more, it is likely to run bacteria count up. But this experience shows that a cow can have mastitis caused by dangerous bacteria and still show no signs of inflammation. If there is any question about a cow's condition, it is better to "play safe" every time. The loss of milk from a single cow is nothing compared with the loss that results from a loss of market for several weeks and no matter how good one's reputation is, even when the trouble is over, it takes consumers a long time to get over their suspicion of your milk. The experience also shows that no one with a sore throat should milk cows or handle the milk in any way. Finally, I have got a different idea than I had before of the service of the Health Department and the good in its regulations. We farmers know little about epidemics unless we actually run up against them, which fortunately does not happen very often, but the health authorities know what is going on over a wide territory. It is their business to help dairymen avoid experiences of this kind, and my contact with them convinces me that they are anxious to avoid these troubles. Since milk is a medium that carries these dangerous germs, we should cooperate in every way with the health authorities in their efforts to keep milk in its proper place as nature's greatest food.

DAIRYMAN.

EXCERPTS FROM THE TEXTBOOK, "PREVENTIVE MEDICINE AND HYGIENE," SIXTH EDITION, BY DR. MILTON J. ROSENAU, PROFESSOR OF PREVENTIVE MEDICINE AND HYGIENE AT HARVARD MEDICAL SCHOOL, AND FORMERLY DIRECTOR OF THE HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE: PUBLISHED BY D. APPLETON - CENTURY COMPANY, NEW YORK.

Page 147: "Milk-borne typhoid is always due to raw milk. There is no instance on record of such trouble coming from properly pasteurized milk.

Page 391: "The mode of transfer (of undulant fever) is usually through raw milk and sometimes through dairy products containing Brucella; or by direct contact with infected animals or their tissues."

Page 393: "The Brucella genus is readily killed by heat.... I have shown that 60 degrees Centigrade for twenty minutes is sufficient to destroy the melitensis strain in milk and provides a margin of safety. Murray, McNutt and Purwin found that the temperature of pasteurization (62 to 63 degrees Centigrade) killed Brucella in three minutes."

"Undulant fever is usually contracted by drinking raw milk or by contact with infected animals."

Page 395: "Our knowledge of the cause and modes of transmission of undulant fever makes the prevention of this disease in man a comparatively simple problem. The reservoir of infection is in livestock. Prophylaxis that would be fundamental and enduring consists in its elimination from our domestic herds. This is not easy. Even though herds be clean, they are readily reinfected."

"Milk, including goat's milk, should be pasteurized.

Page 781: "The diseases conveyed through milk are: tuberculosis, typhoid fever and paratyphoid fever, food infections, diphtheria, scarlet fever, septic sore throat, Malta fever, undulant fever, foot and mouth disease, and milk sickness; also some of the summer complaints of children, and the diarrheal and dysenteric diseases of adults, which are often referable to infected milk. Epidemic arthritic erythema and infantile paralysis have been added to this list."

Page 782: "When all the facts are brought together they make a strong indictment against raw milk. Thus the official record of milk-borne infections in Massachusetts tells the story. Since the general adoption of pasteurization for the milk supplies of the large cities in Massachusetts, milk-borne outbreaks occur characteristically in the small unpasteurized supplies."

Page 783: "Live tubercle bacilli have not been disclosed in pasteurized milk."

Page 784: "It is clear that raw market milk furnished all large cities and probably most small towns often contains tubercle bacilli."

Page 784: "Of milk-borne epidemics, typhoid fever takes the lead.....All outbreaks occur on raw milk routes."

Page 786: "The Boston outbreak (of septic sore throat), in 1911, was characterized by its extraordinary virulence and comparative immunity of children, and high mortality among the aged and infirm. In this outbreak there were over 2,000 cases with about 48 deaths. One of the features of special interest was that the milk incriminated had always been a particularly clean, fresh and satisfactory supply. It was obtained from tuberculin-tested cows under veterinary supervision, and the milk itself subjected to frequent chemical and bacteriological tests. The milk was bottled at the dairy, the bottles were sterilized, and many extra precautions were taken to insure its cleanliness. For twenty-eight years not a breath of suspicion was attached to this milk until this catastrophe occurred. It emphasizes the lesson that raw milk is apt to be dangerous milk, and our only protection against these particular dangers is through pasteurization."

"Another instructive outbreak reported by Benson and Sears, occurred in Portland, Oregon, March 24 to 31, 1922. In this epidemic there were 487 cases and 22 deaths. "Almost all of the cases and all but one of the deaths occurred among people who had drunk raw milk from one dairy which had been rated as one of the best in the city." This is the common story."

Page 789: "Milk-borne outbreaks of disease are always due to raw milk: often milk of good quality, even certified milk. There is no record of a milk-borne outbreak attributable to properly pasteurized milk."

Page 790: "Pasteurization prevents sickness and saves lives. Pasteurization is not ideal, but only expedient. It is advocated because milk is apt to convey the viruses of a number of diseases harmful to man. Pasteurization effectively prevents this hazard. It implies precaution, protection and prevention. It is the best insurance both for the industry and the consumer, and the simplest, cheapest, least objectionable and most trustworthy method of rendering infected milk safe. Next to water purification, pasteurization is the most important single prevention measure in the field of sanitation.

Page 792: "No one should drink raw milk that cannot be guaranteed by the health officer as safe and free from danger. Even certified milk or milk of equally high character is only reasonably safe without pasteurization...There is no authentic record of any milk-borne epidemic caused by properly pasteurized milk."

Page 793: "Inspection (by the health department) gives us a cleaner and better, but not necessarily safe milk. Inspectors cannot be present all the time, and furthermore, even if they were Pasteurs, they could not see missed cases and carriers. Pasteurization destroys the dangers inspection cannot see. The combination of inspection and pasteurization corresponds in all respects to the modern principles of furnishing a safe water supply to a large city. The watershed, through inspection, is kept as clean as practicable, but the water is filtered or chlorinated to protect the consumer.

"There can be no more objection to the heating of milk for the use of adults or children above the age of one year than there is to the cooking of meat. Infants should receive breast milk. There is no adequate substitute. When this is not possible, they should have the best and freshest cow's milk that can be obtained. Whether such milk is to be pasteurized, modified, boiled or otherwise treated rests with the pediatrician. Pasteurization has the well-nigh unanimous endorsement of sanitarians and pediatricians."

THE PASTEURIZATION OF MILK

By C. J. Babcock, market-milk specialist, Division of Market-Milk Investigations, Bureau of Dairy Industry

UNITED STATES DEPARTMENT OF AGRICULTURE
Leaflet No. 177, January, 1939.

Milk is a medium in which bacteria live and multiply, and there are a number of ways in which they may enter an unguarded milk supply.

The vast number of people engaged in the production and handling of a city's milk supply makes it physically impossible for health authorities to be sure that some of the milk at some time will not come in contact with a so-called "carrier," that is, a person who unknowingly harbors organisms of a communicable disease. It is also impossible to be sure that all dairy farms are free from a polluted water supply and other sources of contamination, or that the milk from a diseased cow will not inadvertently enter the milk supply. Because of such uncertainties, a city or community that permits the general use of raw milk cannot consider itself free from the danger of milk-borne diseases.

Science, however, has developed the process of pasteurization, which if properly performed, makes the milk supply safe for consumption and at the same time maintains the nutritive value of the milk.

STATUS OF PASTEURIZATION

The pasteurization of milk for direct consumption, as applied under commercial conditions, means a process of heating every particle of milk to a temperature not lower than 142 degrees F. for not less than 30 minutes (holder process), or to a temperature not lower than 160 degrees F. and holding at that temperature or above for not less than 15 seconds (short-time, high-temperature process). After the milk is pasteurized, it is immediately cooled to 50 degrees F. or lower.

The holder process of pasteurizing milk is the method most generally practiced today. Some cities prohibit the use of the short-time, high-temperature process.

Pasteurization is at present favorably regarded by most physicians, sanitarians, dairymen, and consumers. As a result there is a constantly increasing trend toward pasteurization throughout the United States. At present more than 80 percent of the milk supply of cities having a population above 75,000 is pasteurized. As the relative size of the city increases, the percentage of the milk that is pasteurized increases, and very little raw milk is sold in the large cities. In the smaller towns and rural districts, however, only a small proportion of the milk is pasteurized. The United States Department of Agriculture recommends efficient pasteurization as a safety measure and advocates the pasteurization of all general milk supplies.

FACTS CONCERNING PASTEURIZED MILK

Considerable opposition has attended the development of the practice of pasteurizing milk, and some opposition still exists. Most of the objections, however, have been based on theory, or on experiments and experience in which the milk has not been pasteurized under properly controlled conditions.

One of the early objections to pasteurized milk was that heating destroyed the lactic acid-producing bacteria but not the putrefactive organisms. It was contended that these putrefactive organisms, relieved from the restraining action of the acid-forming bacteria, would develop and form toxins and putrefactive products. It is now known that pasteurized milk sours in a manner similar to that of high-grade raw milk and that there is no more reason to fear the growth of excessive numbers of putrefactive organisms in it than in any other high-grade milk. Pasteurization, however, does destroy many of the lactic acid-producing bacteria, most of which get into the milk with dirt, and this accounts for the fact that pasteurized milk usually keeps longer than raw milk.

Another contention has been that bacteria grow faster in pasteurized milk than in raw milk. Experiments, however, have shown that the rate of bacterial increase is approximately the same in raw milk and in pasteurized milk having about the same bacterial content.

It is often stated that pasteurization even though it kills bacteria, does not destroy poisonous products of their growth. If poisonous products of bacterial growth are present in raw milk, however, and if pasteurization does not destroy them, the pasteurized milk would be no worse than the raw milk. The important point, of course, is that efficient pasteurization will kill all disease organisms that find their way into the milk, and they are certainly less dangerous when dead than when alive.

Objection to pasteurization has been based also on the supposition that it would have an unfavorable influence on the milk producer. It has been asserted that pasteurization would lead to lax methods on the farm because farmers knowing that the milk is to be pasteurized, would be careless in its production. However, only milk of high quality should be pasteurized, and at the present time standards of sanitary quality are prescribed for raw milk that is to be pasteurized.

It has also been contended that pasteurization may be carelessly done and therefore that it is not infallible. A study of the milk-borne epidemics of disease shows that even in the early days of pasteurization, pasteurized milk was safer than raw milk. Moreover, the present practice of official inspection in all pasteurizing plants greatly reduces the likelihood that the process will be carelessly performed.

The question of whether pasteurization destroys beneficial enzymes is still open. In the light of the present knowledge of the enzymes in milk and the part they play in the digestive process, it is quite impossible to settle the question of their importance. It is evident, however, that the present methods of pasteurization have little effect on most enzymes.

It is frequently stated that vitamins are destroyed by pasteurization and if this were so it would be important, especially in infant feeding. Of the several vitamins present in milk only one, vitamin C, which prevents scurvy, is impaired. However, milk is ordinarily such a poor source of this vitamin that when used as the only food as in the case of babies it should be supplemented with antiscorbutics such as orange juice or some other suitable fruit juice.

Serious objections have been raised to pasteurized milk on the theory that the heating produces chemical changes that render the milk less digestible, particularly for infants. Feeding experiments with babies, in which some were fed raw milk and others pasteurized milk, have shown there was only a slight difference in the average net daily gain in weight during the feeding period. The slight difference was in many cases in favor of the pasteurized milk.

Consumers sometimes object to pasteurized milk because of a cooked taste. If a cooked taste occurs, it is due to overheating or to heating too rapidly. Properly pasteurized milk is equal to raw milk in flavor. With present apparatus for pasteurizing milk, temperatures can be so controlled that the flavor is not affected.

It has also been stated that pasteurization reduces the cream line. When this occurs, it is due to overheating. In experimental work, milk heated to 143 degrees F. for 30 minutes showed practically no decrease in the cream volume, and in some cases an increase resulted. Moreover, a slight reduction in the cream line would not mean that any cream had been taken out of the milk.

The fact that pasteurization increases the cost of milk is a frequent argument against pasteurizing milk. When milk is pasteurized in large quantities the cost is but a fraction of a cent a quart. Naturally the smaller the quantity of milk handled, the greater the overhead, and therefore the cost may rise to approximately a cent a quart. From the standpoint of safety, efficiently pasteurized milk as compared with the same milk in its raw state is easily worth a cent or two a quart more. The additional cost of pasteurized milk is cheap insurance against milk-borne diseases.

It is frequently stated that pasteurization is unnecessary in the country, where milk goes directly and promptly from producer to consumer. The fact that a large proportion of the epidemics of milk-borne disease occur outside of the large cities and that a large percentage of these epidemics have had their source on the farms, shows that pasteurization is as necessary in the country as in the city.

HOME PASTEURIZATION

Where it is impossible or impracticable to obtain pasteurized milk, milk may be conveniently pasteurized in the bottles in which it is delivered. Remove the cover from one bottle, pour out a little of the milk, punch a hole in the cover, replace the cover, and insert a thermometer. Then set all the bottles of milk on a rack in a pail filled with cold water nearly to the top level of the milk and heat until the thermometer in the milk registers 145 degrees F. Remove the pail from the heat and leave the bottles in the hot water for 30 minutes, reheating if that is necessary to keep the milk at 145 degrees F. After the 30-minute period, replace the hot water gradually with cold until the milk has cooled, preferably using ice in the last water. After cooling, keep the bottles in the coolest place available.

VALUE AND NECESSITY OF PASTEURIZATION

The value of pasteurization is greatest when applied to the general milk supply. The pasteurization of milk, when the process is properly performed, affords protection against pathogenic organisms. There have been reported in the United States numerous outbreaks of typhoid and paratyphoid fever, diphtheria, septic sore throat, scarlet fever, dysentery, and gastroenteritis traceable to raw milk. Investigators have shown that the thermal death point of pathogenic bacteria ordinarily found in milk is relatively low and that where epidemics have been due to milk, efficient pasteurization was effective in controlling the spread of the epidemic through the agency of milk. Furthermore, it is known that certain diseases of the cow may be transmitted through the milk to human beings. Among human diseases so transmitted are tuberculosis and undulant fever. It is therefore absolutely essential to have a method of rendering the general milk supplies safe. Pasteurization is that safeguard.

SHOULD ALL PUBLIC MILK SUPPLIES BE PASTEURIZED? And if So, Why?

By
Prof. R. M. Washburn
Reprinted from The Milk Dealer, September, 1931

An epidemic has hit us again, but this time, fortunately, it is only an epidemic of propaganda instead of being an epidemic of some preventable disease. The disease may be expected later, if the anti-pasteurizationists have their way about it.

Anyway, this would seem to be the feeling of the "Committee on Milk," U. S. Public Health Report, June 19, 1931, who wrote:

"To counteract raw milk propaganda based upon unscientific evidence, this committee quotes several studies which find pasteurized milk the nutritive equivalent of raw milk, and urges the U. S. Public Health Service to settle the question once and for all."

The differences between "the two schools" are not so much questions of facts as they are of opinion concerning the value or weight of the facts. The economic losses of the thousands of men and women temporarily incapacitated by some disease, as well as the value of a life whether it be man, woman, or child--these are the things which offset and more than outweigh in the minds of many any possible superiority that raw milk, as such, may have over milk which has been heated.

The contention of those who advocate the pasteurization of milk is well told in a paragraph from "The Pasteurization of Milk" in Western Dietitian, June, 1926, page 30, which reads:

"One prevailing popular idea should be commented upon. That is, that pasteurization is a process by which inferior milk is made usable. This is a mistaken notion. Pasteurization will not make good milk out of bad. It will not improve poor quality milk. It will not make clean milk out of dirty milk, but it does make clean milk safe milk. Proper pasteurization does not affect the flavor, odor, appearance, or cream line of milk, materially alter its chemical components, nor diminish its digestibility or nutritiousness."

It was in 1857 that it was first definitely proved that milk could be the means of spreading contagious diseases among humans. At that time there were few public agencies concerning themselves with the public health--epidemics ran their courses without investigation; but by 1880 the matter had become sufficiently serious as to attract public attention so that better records were kept, though often by private individuals. From 1881 to 1926 there were recognized and reported 791 milk borne epidemics in the United States.

During the last quarter century in this country cities and towns have grown tremendously in populations, but even more significantly in their control of the public health. This control has had to do with the water supply, the milk supply, the fly supply, sewage disposal, and the general sanitation of streets and alleys. One of the elements of interest in this connection is the almost complete disappearance of what was known as the "town cow." Instead, there has grown up around the several towns and smaller cities a large number of dairy farmers who make it their business to produce milk in the country and sell it in the towns.

Many of these farmers are naturally clean in their habits and naturally intelligent, but they are not naturally educated with respect to bacteria, culture media, methods of disease spreading, nor in the recognition of disease epidemics.

This is the reason that in 1912 the Medical Milk Commission felt it necessary to lay down 97 specific rules for the guidance of the dairyman. It is a little difficult to visualize a practical dairyman applying 97 varieties of "do's" and "don'ts" with respect to milk production, and yet there are that number that apply to the production of certified or certifiable milk. But even with these safeguards and precautions, several epidemics have occurred with certified milk as the vehicle.

An article entitled "Should Certified Milk be Pastourized" in American Journal of Public Health and the Nation's Health, has this to say:

"While we advocate pasteurization, and have advocated it for many years, we still believe that raw certified milk is as good or better than a poorly pasteurized product, or one which has received proper treatment, but careless after-handling. In this connection, it might be stated that the term pasteurization should not be qualified. If the treatment is not properly carried out, it is not pasteurization, and the process should not be blamed, as it often is, for the faults which lie in apparatus or in operation."

Or, in other words, a first class raw milk is as good as a second class pasteurized milk. Today we believe the reverse.

Many dairymen, of course, are not attempting to produce certified milk but simply a so-called sanitary or "Grade A" milk. All appreciate that a clean milk is far better than one not clean, that a Grade "A" is doubtless better than a "B" or "C" milk. We all believe in sanitary production, but here is the pinch in the matter. All milk, even the best of milk, yes, even certified milk, may become infected with a specific communicable disease and thereby transfer it to the human being. This is not speculation--it has occurred.

The situation can be likened to a farmer and his wheat. The wheat itself may be shrunken, immature, or moldy and thus unfit for seed. On the other hand the wheat itself may be excellent and yet be infected with mustard or wild oats which would cause specific trouble were that wheat sown without first being treated for the removal of the trouble makers. When milk is consumed it is, in fact, a sowing of whatever bacteria there are in the milk, in the culture tube of the body. Many types of bacteria die, some live, some grow--there are thousands of kinds of bacteria with many diverse natures. Our jobs as dairymen consist in giving the consumer a milk which is not only clean, sound and wholesome in and of itself, but which is also free from the "wild oats and mustard."

For a hundred years or longer it has been known that the milk of sick, emaciated, or fatigued cows is not as good as the milk from healthy and contented ones. The infant mortality was shockingly great in some of our American cities during the "good old days" of keeping herds of cows in the cities, in basements, or other foul places where they were fed almost wholly upon what was well termed "swill." Both the cows and the food were unfit for the making of a wholesome milk. We older men recall readily the fight that was made by these so-called "swillers" to maintain their systems of production despite the effect of their product on their neighbors' children. Public attention was directed to this as early as 1836. Public sentiment prevailed, but it was not until about 1906-1910 that herds were dispersed, removed to the country where they belong. They are now kept under better conditions than ever before. The raw milk produced today in this country is far superior to that produced 40 or even 25 years ago, and yet this is what the department of health of Canada (Pub. No. 36) has to say regarding "Pasteurization of Milk for Small Communities."

"Raw milk is safeguarded in the careful supervision of processes of handling and by medical supervision of employees. While this supervision does much to reduce the possibility of infection, experience has shown that the risk of contagion is by no means small. Epidemics spread by supposedly carefully regulated raw milk supplies are of frequent occurrence. The United States Public Health Service has issued a statement showing that 31 epidemics were reported as occurring in the United States in 1924, all of which were caused by infection of raw milk supplies. In one case, the paratyphoid epidemic of New Rochelle, U. S. A., reported by Dr. Huntington Williams in the Journal of the American Medical Association, the infection was spread by the raw milk of a certified dairy. Contagious diseases are practically never spread by properly pasteurized milk."

Dr. S. J. Crumbino, general executive, American Child Health Association, stated in an address before the Association of Dairy, Food and Drug Officials of the United States, meeting at Lincoln, Nebraska, the following:

"Undulant fever is a lingering illness that weakens and incapacitates its victims over a long period of time, even of years. It is not a disease to be considered lightly. Since the source of the contagion is milk, we can prevent the disease by rendering the milk supply clean and safe. There is unanimity of proof that pasteurization at the standard temperatures is completely effective so far as the organism causing undulant fever is concerned."

"With each new advance in the knowledge of infectious diseases, we are impressed with what appears to be the increasing health hazard in relation to those diseases due to the consumption of raw milk."

Thus we see that ills other than those of long acquaintance are coming in for their day.

The following statement of the Department of Health of the State of New Jersey, is to the point:

"It is manifestly unfair, of course, to lay upon this one malady (undulant fever) the whole responsibility for requiring pasteurization. Outbreaks of four other diseases-- typhoid fever, scarlet fever, diphtheria and septic sore throat-- have been traced to the use of raw milk so many times and in so many parts of the country that, were undulant fever unknown, the argument for pasteurization would still be substantially the same.

"In New Jersey alone, during the last 13 years, 22 outbreaks with 658 cases of the first three of these diseases were attributable to raw milk. None could be assigned to pasteurized milk in those 13 years, although such milk constituted the major part of the supply of the state.

"Efforts of milk producers to rid dairy herds of tuberculosis, contagious abortion and mastitis are important contributions to the production of clean milk. Such efforts, however, offer no protection against milk-borne infection of the type which caused the 658 cases of typhoid, scarlet fever and diphtheria.

"The only practical way yet devised of combining safety and moderate cost is milk pasteurization."

Here are 1,365 more reasons for pasteurizing milk and ice cream mixes: In the single state of Massachusetts for the three years, 1927-1928-1929, there were 10 outbreaks of contagious disease, all traceable to milk as a carrier of the illness, according to **American Journal of Public Health**, October 1930, issue. In these 10 outbreaks 1,365 persons were affected and 68 died. Of these deaths, 48 were cases of septic sore throat.

"Nineteen twenty-nine is the first year (in Massachusetts) since the first outbreak of typhoid fever was reported, in 1886, that has not witnessed an outbreak of milk-borne typhoid fever. There has been no outbreak of milk-borne diphtheria for four years."

The general benefits of pasteurization were shown by Louis Pasteur about 1865 and adopted in Sweden and Germany within a few years. A generation later it was applied and made useful in the United States by that great philanthropist, Nathan Straus. But it required almost another generation to get the process into wide usage, and even today a large part of the milk consumed has not been treated to insure safety to the consumer. Several states soon passed laws requiring that skim milk and whey be pasteurized to prevent infecting the pigs and calves, though they still permit raw milk to be sold for human consumption.

The proponents of raw milk usage are still telling consumers that raw milk is by far superior as a food for their young and in some cases even strongly suggesting that the pasteurization of milk, in and of itself, renders the milk all but unfit for use. One supposedly scientific paper in particular has been widely circulated to increase the sale of raw milk. Not only does this paper draw conclusions unwarranted by the data presented but in addition totally ignores the communicability of specific and various human diseases and the part that milk has played for more than three-quarters of a century to our knowledge, in the spread of such diseases.

Fortunately, disease germs are easily killed by heat. Diphtheria germs are killed by the heating of milk to about 131 and septic sore throat, and communicable cold germs are killed at about 134, while typhoid fever germs require 137 and tuberculosis germs about 139. With these things established the pasteurization of milk has been fixed by statutes and ordinances at 143 to 145 degrees. Then to make assurance doubly sure, the milk is to be held at such temperature for half an hour. The relation of temperature to germ destruction is well illustrated in the graph of eight thermometers shown in this article.

Pasteurization has been going on for many years, with millions of children thriving on such milk, but now we are told that the temperature of 145 materially injures some valuable property of the milk. We wish at this point to call the attention of the raw milk enthusiasts to the fact that the mothers of Europe have been scalding the milk at 185 degrees for their babies or even boiling it, at 212 degrees, for centuries, and they are still doing it. The Swiss people, noted for their sturdiness, are as infants fed on boiled milk. Throughout all southern Europe scalding or boiling of the milk has been a traditional housewifely knowledge for we know not how many centuries, and is still taught not only by mothers to daughters, but by physicians both there and here.

Dr. Abraham Jacobi, formerly of Columbia University, said:

"The most important thing in the case of infants is just this: 'Use no raw milk.'"

Dr. Jacobi first advocated boiled milk in the United States in 1869, and yet, after 50 years of wide practice, he held the same view, if anything more strongly than at first.

When the work of the renowned Robert Koch made the identification of tuberculosis in cattle possible, and it was found that a high percentage of all European cows were tubercular, then milk was ordered to be pasteurized and pasteurization was established at 185 degrees and has continued. Moreover, the preservation of evaporated, sterilized milk in tins requires a temperature of about 235 degrees maintained for 15 to 20 minutes, and yet on this milk thousands of children are being raised. The children of the white residents in China, India, Africa, Central America, Alaska, Philippine Islands and many mining and lumber towns of this continent are being raised very largely on sterilized, evaporated milk which has been heated to a temperature, not 145, nor 185, nor yet 212, but to 235, and still they thrive. Infants and young children of our cities are also thriving on sterilized milk.

Here is what the same U. S. Bureau of Public Health has to say regarding the general safeguarding of the milk supply in this country:

"With growth in our milk industry, with its complicated methods of collection, shipping, and distribution, the difficulty of properly controlling the quality of the market article has greatly increased. Milk is subject to infection from the time before it leaves the cow to the time of its consumption, and when once infected, it is an excellent culture medium for the growth of many kinds of bacteria."

"In 1912 the American Association of Medical Milk Commissioners laid down 97 different rules and regulations which represented in its opinion minimal requirements for the protection of a raw milk sufficiently safeguarded to be sold as 'certified milk.'"

"When we consider milk derived from 21,000,000 cows scattered over the whole of the United States on some 4,500,000 farms and handled by millions of people the impossibility of securing an adequate supply of properly safeguarded raw milk at a price within reach of the masses is evident. The solution of the problem in minds of most sanitarians lies in surrounding milk production with all practicable safeguards and then adding additional and essential safeguard of adequate pasteurization in machines of proper and approved design properly operated and controlled, the pasteurized product should be promptly cooled, put into sterilized containers, capped without the use of human hands, and promptly delivered

to the consumer. Boiling in the home constitutes the last word in furnishing the family a supply safe from infection."

In one of the papers referred to from which the raw milk advocates have gathered evidence that pasteurization is injurious, the conclusion is based upon the well being of eight (8) white little rats, whereas on the other side of the question, we have thousands, yes, tens of thousands of strong human children growing healthfully, thriftily, as children should on pasteurized milk. Moreover we have as evidence a most remarkable test made at Washington, D. C., in which 208 human babies were fed on raw milk and 111 on a part of the same milk pasteurized. At the end of 18 months those receiving the raw milk had gained an average of .4253 ounces per day per child and the pasteurized milk group had gained .4274 ounces per day.

Dr. C. A. Harper, secretary, Wisconsin State Board of Health, has the following to say:

"Devotees of raw milk, of whom there are known to be large numbers throughout Wisconsin, are continually threatened by two particularly dangerous enemies, typhoid fever and septic sore throat, and their children are endangered by scarlet fever.

"In scattered localities, chiefly the larger cities of the state, local milk ordinances lessen the danger of contracting these diseases, by means of rigid sanitation provisions, but in the greater area of the state unpasteurized milk frequently has given rise to serious epidemics and innumerable instances of contagion.

"Septic sore throat has reached epidemic severity in a number of communities during the past five years, and all of these epidemics have been traced to the milk supply of the victims.

"To the old question as to whether safeguarding milk should fall to the duty of the community or the milk industry, leading cities of the state have assumed the duty from a municipal standpoint, and the state board has urged that this public health measure be adopted by the smaller communities until all milk produced in Wisconsin will be so handled as to be absolutely safe.

"The majority of raw milk drinkers in this state, the board believes, drink it from necessity rather than from choice, due to lack of pasteurizing facilities in the rural reaches."

Here we quote from the 1924 Annual Report of Dr. E. R. Kellay, Commissioner of Health, Massachusetts State Department of Health, and from among the last things which he wrote:

"The fact that milk under the greatest precautions and highest standards of general cleanliness can still transmit virulent tubercle bacilli and the organisms of typhoid, scarlet fever, diphtheria, and septic sore throat, not to mention various

minor types of infection, has led the health authorities of the state at large persistently to advocate efficient pasteurization. As a result, epidemics from the four diseases mentioned have become very rare and the total number of cases traced to milk has fallen from an average of well over 1,000 annually for the years 1907 to 1915 to an average of a little over 100 for the past four years. During the same four years the percentage of the total pasteurized milk supply of the state has increased from 34 to over 75, with many of the large cities reporting over 90 per cent pasteurized. Many important legislative measures, both statewide and of local application, have been made effective, culminating during the present year in action by several progressive cities which in effect provides that in the future no milk can be sold in those cities unless it is both of a high grade of cleanliness and efficiently pasteurized, or, if sold raw, that it must be from herds officially certified to be entirely free from tuberculosis."

One of the most conspicuous milk-borne epidemics in recent times occurred in Canada last autumn and was reported in the Canadian Public Health Journal, May, 1931. It says:

"A severe epidemic of septic sore throat occurred in Kirkland Lake, Ontario, in December, 1930. In a few weeks over 450 cases and four deaths were thereby added to the toll of disease spread through the use of raw milk."

The science of preventative medicine and the science of public health administration have grown up with the past quarter of a century.

Dr. Milton J. Rosenau, Professor of Preventative Medicine, of Harvard University, says:

"Pasteurization saves lives and prevents sickness. It does not injure the quality of the milk in any way and does not diminish its nutritive value. Pasteurization is the cheapest form of life insurance that the customer can take out."

The U. S. Public Health Service says:

"Milk is second in importance only to water as a vehicle of disease transmission."

Others who are in a position to know the facts, yet are in a neutral position in the matter, may be quoted:

Dr. Thomas D. Wood, Columbia University:

"At the present time, on the basis of the evidence within my knowledge, I believe that compulsory pasteurization for all milk is a desirable safeguard for the public health."

Dr. W. A. Evans, national authority on foods and health, says:

"In the spring of 1912 there was an epidemic of septic sore throat which again emphasized the hazard of raw milk

supply in a city. In this epidemic there were 487 cases of epidemic septic sore throat. There were 22 deaths. This is a rather heavy bill to pay for the privilege of drinking raw milk. Of the cases, 23 drank the milk in a hospital and 104 in a girls' home. The remainder were in private homes. Some hospitals and some girls' homes are not free from the folly of drinking raw milk. Pasteurization as a routine would have prevented it."

Dr. Wm. H. Peters, Health Commissioner of Cincinnati, says:

"All certified and inspected milk in Cincinnati, after December, 1929, must be pasteurized, by order of the board of health, in co-operation with the milk commission of the academy of medicine and the producers. Certified and inspected milks were always rated high; but the opinion prevailed that both would be just that much better after pasteurization, which we look upon as an additional safeguard."

S. J. Crumbine, M. D., executive officer, American Child Health Association, in a paper on "A National Co-operative Campaign for Clean and Safe Milk," given at the seventeenth annual convention of the International Association of Dairy and Milk Inspectors, said:

"It is noted that in the larger cities the consumption of pasteurized milk is greater than in the smaller ones. As in the case of water, so we have the anomalous situation that the safest water and the safest milk is that distributed by the larger cities. By the same token typhoid fever has become almost unknown in the larger cities; indeed, this disease is now sometimes known as the rural disease, depending chiefly upon its dissemination through unguarded water supplies and unpasteurized milk supplies."

Appreciating all those things the Illinois State Department of Public Health in co-operation with the medical college is undertaking a campaign of education of consumers of milk, especially in smaller places, and have the following to say:

"The advantages of pasteurized milk need not be dwelt upon in this journal. Our purpose is to report experiments upon the use of vacuum and insulated heat retaining bottles to pasteurize milk in small quantities for home use. This is a part of a program of the Illinois State Department of Public Health to reduce infant mortality in communities too small to enjoy the benefits of commercial pasteurized milk."

And we notice in the report of "Subcommittee on Communicable Diseases Transmitted Through Milk" (preliminary report of White House Conf.), reported in U. S. Public Health Report, April 3, 1931, Vol. 46, p. 776:

"The probable reason for the higher incidence of milk-borne epidemics in the small country towns and rural sections, and the cities of from 5,000 to 25,000, is that in such com-

munities we find the larger population groups being served almost wholly by raw milk; that is, milk not produced under effective or, in the majority of instances, any source of continuing controlling."

Our national neighbors to the south as well as north take a position well expressed by Dr. Charles Hastings, Medical Officer of Health, Toronto, Canada, who said:

"It is inconceivable how any thinking person will, in the light of modern knowledge, jeopardize his own reputation by advancing arguments against the scientific pasteurization of milk. In my judgment, any municipality failing to safeguard its milk supply by means of scientific pasteurization is, in the light of modern knowledge, guilty of criminal negligence."

The several common chemical components of milk are not injured by heat, so far as experience or test has yet shown and there are decided physical benefits as well as health insurance. There are six or seven kinds of vitamins and all are found in milk. Of these, the one that prevents scurvy, called "C," is the only one that is injured by heating. It is reduced about one-half. But there is a deficiency of this vitamin in milk anyway under practically all conditions of production, thus requiring that orange or tomato juice be administered to infants and that most any fruit or vegetable be used by older children and adults.

Simmered down to its last analysis, the question is whether we should encourage a milk containing the last possible traces of vitamin "C" value or whether we should encourage the consumption of milk, produced the best that science and economics will permit, made safe by pasteurization.

EXCERPTS FROM:

"THE NUTRITIONAL ASPECTS OF MILK PASTEURIZATION"

By Dr. E. V. McCollum, F.A.P.H.A., Johns Hopkins University
Baltimore, Md.

Internationally known Expert on Nutrition and Health of the
League of Nations

From the American Journal of Public Health, Vol. 24, No. 9,
Published by the American Public Health Association, 50 West
50th St. N. Y. C.

"The evidences of animal experiment do not show any
nutritional differences between raw and pasteurized milks."

"There is no convincing evidence that raw milk, even
if it were safe, is superior to pasteurized milk in infant
feeding. Pasteurized milk is probably better since it is more
easily digested. The growing practice by pediatricians of
boiling milk or of feeding evaporated milk to infants, shows
that it is certainly satisfactory. The idea of splitting hairs
over slight assumed differences is absurd."

"The heating of milk is so great a safety factor in
preventing disease that there should no longer be any argument."

"We have an immense amount of clinical evidence
gathered from many countries which shows that pasteurized milk
has fulfilled the needs for feeding infants and children over
many years, with no evidence of damage."

"The opponents of pasteurized milk have conspicuously
failed to make a case against it in favor of the raw product.
The marked lessening of incidence of intestinal troubles and
contagious diseases carried by raw milk accomplished by pas-
teurization makes it hard to understand how opposition can
longer be justified."

"The Lanarkshire, Scotland, study of 10,000 children
receiving three-quarters of a pint each daily - 5,000 raw,
grade A milk and 5,000 pasteurized milk - with 10,000 as con-
trols, gave clear evidence of the beneficial effect of milk
feeding on the rate of growth. There was no difference in the
raw and pasteurized milks."

"Schounert and Bischoff studied the food value of
raw and heated milk, and found no detectable change in food
value. These experiments furnish cogent evidence that cooking
(foods other than milk as well as milk) as ordinarily practised,
does not interfere with its usual influence on cell metabolism
or prevent its utilization for such characteristic demands as
growth and reproduction."

"Fortunately we now have available an excellent study
of Leslie C. Frank and others of the U. S. Public Health Service,
which should finally silence the critics of pasteurized milk.
These investigators studied children fed raw and heated milk,
supplementing the diets ordinarily received by American Children

in 39 cities and in 10 states. The children to the number of 3,700 were from 10 months to 6 years. The report states:

"The growth-promoting capacity of heated milk plus the supplementary diet received by the average American child of 10 months to 6 years is not measurably less than the growth-promoting capacity of raw milk plus the supplementary diet received by the average American child of 10 months to 6 years. Children who are fed pasteurized milk thrive as well as children who are fed raw milk, and contract certain communicable diseases less frequently."

"The average weight of the children in the two groups was 33.6 and 33.2 lbs. respectively for those fed heated and raw milk. There was no significant differences in the heights of the children of the two groups, i.e., 37.5 and 37.4 inches respectively."

"The report shows a significantly higher incidence of diphtheria, scarlet fever, and intestinal disturbances among users of raw milk."

"Since the effect of pasteurization on the food value of milk is too slight to be apparent even in specially designed experiments, and is not apparent in observations on children living under ordinary American conditions, there is no valid argument which can be brought forward in support of the marketing of raw milk for the general population."

"It seems strange indeed that, when we accept so generally the cooking of most of our foods, there should still remain in certain areas a serious objection to the milk heat treatment of milk involved in pasteurization. The menace of bovine tuberculosis to the health of children is so great that universal pasteurization would be imperative if only for the prevention of the spread of this disease alone among children."

REPRINTED FROM THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, VOL. 115, NO. 20, NOVEMBER 16, 1940, BEING AN EDITORIAL IN WHICH THE AMERICAN MEDICAL ASSOCIATION AGAIN RECOMMENDS PASTEURIZED MILK.

"JUG STATION" MILK

In 1932 the Journal condemned the sale and use of bootleg milk, namely milk offered for sale outside municipal limits and therefore not subject to the regulations governing the sale of milk within the municipality. Several health officers at that time were confronted with the health hazard developed by the sale of milk at roadside stands to residents of nearby cities. Such milk was cheaper than milk sold in the city. Often it came from farms of such insanitary condition that their product could not be offered within the city limits.

Studies by the United States Public Health Service and the former American Child Health Association have demonstrated again and again that milk-borne epidemics are due almost exclusively to raw milk supplies. In many parts of this country, especially the smaller cities, raw milk still constitutes an appreciable percentage of the daily milk distribution. Raw milk unless certified is frequently produced under conditions not conducive to safety. The danger of contamination of raw milk has been recognized even to the extent that producers of certified milk and the American Association of Medical Milk Commissions, which supervises certified milk production, are agreed that pasteurization would be an additional safeguard even for certified milk.

The sale of raw milk continues in spite of the fact that pasteurized milk is safer. Certainly there is no established evidence to indicate that raw milk is any more desirable nutritionally than pasteurized milk. The Council on Foods and Nutrition of the American Medical Association has published the following decision concerning the relative nutritional values of raw and of pasteurized milk.

"Milk is an excellent medium for many dangerous bacteria as well as an excellent food for men. Disease germs may enter the milk directly from an ailing cow, be introduced by insects, or be transferred to the milk by the fingers or mouth-spray of persons having to do with the collection or transportation of milk.

"The pasteurization of milk is a public health measure. The public should demand pasteurized milk for drinking and the use of pasteurized milk in milk products. The dairy trade should universally adopt pasteurization in the interest of public health.

"There is no cogent evidence that pasteurized milk is significantly inferior nutritionally to raw milk."

Even today bootleg milk stations, also called "jug stations" still operate outside the corporate limits and conse-

quently outside the jurisdiction of some cities in which only pasteurized milk, other than certified, is legal. When every possible legal precaution has been taken to protect a community against potential dangers in raw milk, and milk consumers persist in circumventing the local regulations by buying milk from unsupervised sources, the occurrence of milk-borne outbreaks of communicable disease cannot be attributed to any failure on the part of the health authorities. Unless county and state authorities cooperate with city health officials in controlling this menace to health, outbreaks of milk-borne infection are bound to occur.

DAIRYMEN, DISTRIBUTORS, GROCERS, AND RESTAURANT
OWNERS MAY BE HELD LIABLE FOR UNDULANT FEVER

Excerpts from An Opinion of the Supreme Court of Washington Given August 30, 1940, As Presented In the Washington 105 Pacific Reporter, 2nd Series.

The Opinion sustains a judgment of \$7500.00 for a patient who acquired undulant fever from raw milk, and further states that similar law suits may be brought successfully against not only the immediate vendor, but also the retailer, wholesaler, producer, and all others who participate in the sale of deleterious articles, such as infected raw milk.

Hence the dairyman producing raw milk, as well as the distributor, grocer, and/or restaurant owner who sells or serves such raw milk may be held liable should someone become ill from using such raw milk.

(A large number of cases of undulant fever have been reported in Kansas City, Kansas. Although most of the cases were traced to Grade A raw milk sold to homes, and milk sold at milk stands just outside the city, some of the cases were traced to Grade A raw milk sold at stores and served in restaurants.)

CASE OF NELSON V. WEST COAST DAIRY CO. et al
SUPREME COURT OF WASHINGTON
AUGUST 30, 1940

"Where articles of food are sold for domestic use and immediate consumption, the law implies a warranty that articles are sound, wholesome, and fit to be consumed, and if consumer is made sick through consumption of food, he has a right of action against the vendors thereof, either for breach of implied warranty or for negligence, and in such action it is unnecessary either to allege or prove scienter, and consumers right of recovery is not limited to an action against his own immediate vendor, but reaches retailer, wholesaler, producer, and all others who may participate in sale and distribution of deleterious articles."

(Scienter means = Knowledge by the defendant that a certain article or act is harmful, wrong, or contrary to law.)

"Negligence, like any other fact, may be proved by circumstantial evidence, and such evidence sufficient to sustain a finding or verdict for plaintiff if it is shown that in all reasonable probability plaintiff's injuries were proximate result of defendant's negligence."

"In action for injuries as result of negligence if there is proof of probable cause, whether injury resulted in consequence of established cause may be left to reasonable inference."

"In consumer's action against operators of dairy farm, a dairy to which operators sold milk, and individual who conducted milk route selling milk purchased from dairy company for damages sustained from undulant fever contracted by consumer while drinking milk produced and marketed by defendants, evidence warranted finding that most probable cause of consumer's illness was his consumption of infected raw milk furnished by dairy company."

"One who sells milk which fails to conform to the standard prescribed by law is liable, even though the milk has not been tampered with by the seller and is sold in the same condition as when it came from the herd. From the necessities of such situations, and in reason, the consumer's right of recovery is not limited to an action against his own immediate vendor, but reaches the retailer, wholesaler, producer, and all others who participate in the sale and distribution of such deleterious articles of food."

"Undulant fever is a disease which, as indicated by its name, manifests itself in recurring waves. Over a long period of time it may successively intensify and subside. The medical profession has given it particular study since about 1930, but as yet has discovered no cure for it. It has been definitely established, however, that the germ of the disease is the same as that found in "brucella abortus," commonly known as "Bang's disease", to which practically all animals, more particularly cattle, goats, and swine, are subject. Cows that are infected with the disease are likely to eliminate the organism in their milk because the germ localizes itself in the udder, and it has been found that fifty percent of all cows so infected actually do eliminate the organism in that manner. It has also been found that cows which, when tested, show a blood titer of 1-200 almost invariably shed the germs in their excretions, including the milk, and that some cows having a titer as low as 1-50 will do likewise. The higher the titer, the greater and more virulent the organisms, and even milk with an extremely low bacterial count may be heavily contaminated."

"Bang's disease is one of the most contagious diseases to which cattle are subject. One cow can easily infect an entire herd. The incubation period in the animal varies from thirty days to four months."

"According to well-recognized medical authority upon the subject, undulant fever is contracted by human beings as the result of drinking raw milk or by contact with infected animals. If all milk were efficiently pasteurized or boiled before being consumed, there would be no brucellosis (undulant fever) except in those occupational groups whose work brings the individual in contact with infected animals or infected carcasses. Among city dwellers and others who do not come in contact with animals, the chief source of undulant fever is raw milk. The incubation period of the organism in human beings is said to range from two weeks to a month."

"On January 31, 1936, a state test was made of the K&M herd (one of the producers in this law suit), consisting of forty-nine cows at that time. The test was voluntary on the part of the owners of the herd. It showed, however, that eleven cows were infected with Bang's disease, and that three others were "suspects." A subsequent test of the three suspects shows that one is a "reactor", while the other two were clear. All reactors were slaughtered as soon as their condition was discovered. In March, 1936, the whole herd, consisting of fifty-six heads at that time, was again tested, showing no reactors, but three suspected. The suspects were separated from the rest of the herd, and later, upon another test, one was found to be a reactor, while the other two showed "negative." In November, 1936, a suspected animal alone, was tested, and was found to be infected. No test of the entire herd was again made until November, 1937, several months after respondent (plaintiff) became ill, at which time, out of a herd of fifty-seven cattle there were twenty reactors and four suspects."

"A similar test of the Hans. herd (the other producer supplying the dairy) was made in February, 1936. It disclosed two reactors, and they were promptly slaughtered. In April, 1936, a test of twenty-five head disclosed no reactors and but one suspect. No further information concerning the suspect is furnished by the record. No further tests of the Hans. herd was made until September, 1938, at which time out of twenty-five head of cattle, there were three reactors and one suspect."

(This illustrates that frequent testing of cattle does not offer complete protection to either the dairyman or the consumer.)

"Considering the evidence from every angle, we are of the opinion that the trial court was fully warranted in finding that the most probable cause of respondent's illness was his consumption of infected raw milk furnished by appellants, and that in arriving at that conclusion the court was not moved by, nor required to indulge in, conjecture or speculation. It is conceded that respondent had undulant fever; it is shown that among urban dwellers the principle cause of such fever is the investigation of raw milk that is infected with the germs of Bang's disease; it was reasonably established that the cows from which the respondent obtained the milk, through the appellants, were afflicted with Bang's disease during the period of such consumption.....It seems to us that respondent has, by circumstantial evidence, made as clear a case of liability as could be expected or required in a case such as this.....

"The judgment is affirmed."

"To the
HEALTH COMMISSIONERS
of the
CITY OF LOS ANGELES -

A Report on the Local Milk Situation"

by

GEORGE PARRISH, M. D.

Health Officer - Los Angeles City Health Department

(Reproduced with the Permission of Dr. Parrish)

Approximately three score and ten years ago, Louis Pasteur, the world's greatest biochemist and bacteriologist, began his researches on the effect of heat in checking the fermentation in wine, which studies were later to extend to milk and lead to pasteurization. From 1857 to 1863 Pasteur worked with both wine and milk and found that bacteria could be killed by heat. In 1865 he announced to the Academy of Science at Paris, that maintaining wine for a few minutes at a temperature of 140 degrees F. to 158 degrees, kept it from spoiling.

Dr. Jacobi of New York, in 1875, seems to have been the first to recognize the public health aspects of pasteurization and advised the use of heated milk for infant feeding. In 1886, the great German scientist, Soxhlet, continued experiments in pasteurization and devised the first small home made sterilizer. It was not until 1893 that a concerted and concentrated drive was begun on the use of raw milk. In that year, Nathan Strauss established in New York City a well equipped laboratory for furnishing pasteurized milk for infant feeding. In 1897 as Health Officer of New York City, he became distressed over the excessive death rate among the city's waifs living in institutions on Randall's Island. Early in 1898 he erected a pasteurization plant on the island. Without any change in the regimen or diet, except that the same milk from their own herd of cows was pasteurized instead of being served raw, the death rate dropped from an average of 41.8 for the years 1895-1897 to an average of 21.7 for the next seven years. Nathan Strauss really was the pioneer in commercial pasteurization. A close observer and a lover of children, he was driven through desperation to do something to save the lives of the little ones. He said, "In 1892 great number of babies were dying during their first and second year, often one half of them, and in some institutions practically all of them. Sixty-four percent of one week's death roll was composed of babies under two years, who were almost wholly dependent on milk for nutrition." He said, "I sensed the fact that most of these deaths were due to impure milk."

The success of his first station led to the establishment of others until for many years he operated eighteen stations. His annual expenditures amounted to more than \$100,000 a year for many years. Having thus sown the seed of pasteurization as a protection to child life in this country, he wrote, "Thirteen years ago I believed that the pasteurization of milk was the only remedy. Today I know it. There can be no question but that the supply of milk everywhere should be pasteurized, not only that intended for infants, since the use of raw milk for adults is almost equally fraught with danger."

From the days of Strauss down to the present moment, scientific medical men, public health authorities, and the majority of all modern and up to date dairymen have striven to make it probable that the only safe milk is either pasteurized or certified. Raw milk is dangerous. Unfortunately, in the ordinary course of events it takes twenty years or longer for knowledge of a medical discovery to spread through society and become a matter of common thought. During these years milk borne diseases have continued in the United States at the rate of fifty epidemics a year, always claiming their toll of death and leaving many others maimed and crippled. The great struggle for better milk to date has not been without results, for in almost all cities of 50,000 or over throughout the land, approximately 85 % of the milk, or more, is now pasteurized and the percentage is constantly increasing.

In Los Angeles City about 75% of the milk is pasteurized. But it is that one quarter that is still being sold as raw milk that causes uneasiness, unrest, and anxiety to your health authorities. In spite of all diligence and care, who can say what moment some raw-milk-borne epidemic may start and who can predict what dire tragedy and results it may carry with it. Raw milk is and ever has been Public Health Enemy No. 1.

It is too bad people jump at conclusions or are so easily led. So many are prejudiced without reason. What possible objections could anyone have against pasteurized milk? Do you know what it really is, or is it just a name to you? Do you realize what Pasteurized milk means to you or your child?

PASTEURIZATION

Milk should be heated to 142 degrees F. to 145 degrees F. and held for thirty minutes. This is called PASTEURIZATION. This process of pasteurization will kill the viruses (poisons) of tuberculosis, typhoid fever, scarlet fever, diphtheria, undulant fever, dysentery, septic sore throat and other diseases. This temperature will kill practically all the non-spore bearing micro-organisms (bacteria) that cause disease in man.

Heating milk to this temperature does not alter its taste, odor or digestibility. It does not interfere with its food value and has the advantage of preventing much sickness and saving many lives. Pasteurization is the most trustworthy method of rendering milk safe. Only certified milk or milk of equally high character can be regarded as reasonably safe without pasteurization. Pasteurized milk must be handled at least as carefully as Class A raw milk. The combination of pasteurization and inspection spells safety. There can be no objection to pasteurization for the use of adults or children.

Infants should receive breast milk. Babies raised on cow's milk, raw or cooked, should also be given orange juice. Pasteurization has been endorsed by the American Medical Association, the National Association for the study and prevention of Tuberculosis, the American Public Health Association, the United States Public Health Service, the National Commission of Milk Standards, and by all ranking health officers.

WHAT AUTHORITIES SAY OF PASTEURIZATION

The Twenty-Third Annual Report of the International Association of Dairy and Milk Inspectors says: "Pasteurization of milk is now generally recognized, both legally and scientifically, as an essential feature of good dairy practice. Physicians, health officers, agricultural scientists, nutritional authorities, judges and leaders in the Dairy Industry, are all agreed that modern pasteurization sets the final seal of safety on a clean milk supply."

MARY STEWART ROSE, Ph.D., Professor of Nutrition, Teacher's College, Columbia University, "Pasteurization is the safeguard against disease producing bacteria."

WHITE HOUSE CONFERENCE, The White House Conferences called by President Hoover, September 29, 1932, "Pasteurization should be required wherever practicable. Pasteurization is not intended to take the place of the sanitary production of clean and wholesome milk, but rather to provide the final factor of safety from milk-borne diseases."

WILLIAM H. PARKS, M. D., a world's leading authority, New York Health Department. "Raw milk is not free of the danger of causing infection, when consumed by either infants or older persons. Proper pasteurization of milk kills all possible varieties of the disease germs in it which we know to be able to cause infection upon swallowing."

DR. H. E. HAZELTINE, Senior Surgeon of the United States Public Health Service, has frequently ordered all milk pasteurized where the raw milk has caused an outbreak of communicable disease.

CANADIAN PUBLIC HEALTH JOURNAL, in 1932, the Canadian Public Health Journal carried the following editorial: "The Canadian Public Health Association stands unequivocally for the pasteurization of all milk supplies as the one and only means at our disposal for the final safeguarding of the health of the public from the dangers associated with the consumption of raw milk. The necessity for general pasteurization is amply demonstrated every year in our death rates from diarrhea and enteritis, in our milk-borne typhoid epidemics, our septic sore throat outbreaks, the increasing cases of undulant fever and our cripples from bovine tuberculosis."

W. J. TIEDMAN, M. D., New York State Health Department, says:
"No matter how carefully raw milk is produced, pasteurization will make it safer."

AMERICAN JOURNAL OF NURSING, November 19, 1930, "Miss Alice Evans, who has done much research work on undulant fever, says: 'No milk other than certified or pasteurized is safe, for the cattle disease is widespread in the United States. No raw milk is safe unless it comes from a herd that is absolutely abortion free and so certified by the official authorities.'"

DRS. WILL & CHARLES MAYO, Rochester, Minnesota, "If the person milking the cows or handling the milk or the utensils is suffering from an infectious disease, such as septic sore throat, tuberculosis, diphtheria or scarlet fever, there is a strong possibility that they will infect the milk and spread the disease. Milk is the most valuable food, but it should be pasteurized. The value of pasteurized milk cannot be overestimated. Pasteurization is the best of all known treatments of the nation's milk supply and in the final analysis for all its dairy products." (Northwestern Journal).

In a report issued by the Committee on Milk at the Conference of State and Provincial Health Authorities of North America, it said: "Man is a far more important source of disease organisms in milk than is the cow and man is more difficult to control. It is for this reason that properly pasteurized milk is the safest milk."

E. V. McCOLLUM & NINA SIMMONDS, Professor and Associate Professor, School of Public Health and Hygiene, Johns-Hopkins University, Baltimore, Maryland, in their book, Food, Nutrition and Health, wrote: "Pasteurization came into use because of the frequent experiences of health officials that epidemics of typhoid fever, scarlet fever, septic sore throat, etc., were traceable to the milk route. Pasteurization destroys the germs that cause these diseases. These diseases have been spoken of as milk-borne diseases. In order to protect the public against such epidemics the practice of pasteurization was recommended by Pasteur."

DR. LAFAYETTE B. MENDEL, Professor of Physiological Chemistry at Yale University (Thirty years on the teaching staff of Yale School of Medicine) says: "Clean milk is not necessarily safe milk. Milk is only as safe as the man power standing behind it. Our greatest safety lies in the exclusion of the dangerous micro-organisms by effective pasteurization."

SASKATCHEWAN DAIRY ASSN. In 1921, the Saskatchewan Dairy Assn., in Convention unanimously adopted the following resolution:
"Whereas the proper pasteurization of milk has been proven an important safeguard to the health of the consuming public:"

BE IT THEREFORE RESOLVED that this Association go on record as favoring legislation in cities making it compulsory that all milk or cream sold wholesale or retail in such cities, be scientifically pasteurized."

DR. PAUL B. BROOKS. In 1931, Dr. Brooks, Deputy State Health Commissioner, New York State, wrote: "It is doubtful if our raw milk, other than certified, is much safer today than it was ten years ago, except insofar as tuberculosis is concerned. Let us see if the facts support this statement. In the past fourteen years in the state, outside of New York City, we have had one hundred milk-borne outbreaks of communicable disease, ninety-eight of them traced to raw milk. I am every day becoming more convinced that if raw milk is to continue to be sold we should insist on the systematic application of all the actual safety measures now applied to certified milk. It may impose hardships on producers, but if we don't do it, sooner or later the public is going to suddenly wake up, as it has a way of doing, to the situation we have been trying so long to impress on it and say, 'Well, if you knew raw milk wasn't safe, why didn't you do something about it.' The municipal health authorities who in this day and age, permit the sale of ordinary raw milk, when pasteurized milk is available assume a heavy responsibility."

THE METROPOLITAN LIFE INSURANCE COMPANY: "Every rose has its thorns. Milk has its dangers. It is apt to become contaminated and convey the germs of disease. Pasteurization neither improves nor harms the milk itself. Pasteurization itself has only one object and that is to destroy the harmful bacteria. Our only real safety lies in pasteurization."

The Metropolitan Life Insurance Company insures the lives of many hundreds of thousands of people. Its business is to try and make these people live many years. It recommends only those things which are beneficial to humanity and which will bring health and happiness. The Metropolitan Life Insurance Company recommends pasteurization.

MEDICAL STAFF CALIFORNIA HOSPITAL. "Resolved by the California Hospital staff at regular session this May 19th, 1936, hereby endorse the stand of DR. GEORGE PARRISH in his attempt to require all raw milk in Los Angeles City, excepting certified, to be Pasteurized:

Signed

E. J. Cook, Chief of Staff
A. J. Scott, Secretary of Staff"

Membership, approximately 350.

STATE AND CITY HEALTH OFFICERS

FRANK M. CARROL, M. D., Commissioner of Health, Seattle Washington: "90% of Seattle's milk is pasteurized and we hope in the near future to have 100% pasteurized. I am for pasteurization of all milk."

HERMAN N. BUNDESEN, M. D., Health Commissioner, Chicago, Ill.: "All of Chicago's milk is either Grade A pasteurized or certified. Experience teaches that the best milk supply for a community is that which has been produced on clean farms from healthy cows and then properly pasteurized."

LOUIS R. THOMPSON, M. D., Acting Surgeon General, United States Public Health Service: "While it is true that pasteurization should not be regarded as a cure-all and that sanitary inspection at the source is necessary, nevertheless every thoughtful student of the problem must conclude that farm inspection is not infallible and that health examinations of herds and employees occasionally misfire. To make assurance doubly sure all milk should be properly pasteurized before it is consumed."

John G. ABELE, M. D., Health Officer, Portland Oregon: "the greatest worry a health officer can have is to see any part of the milk supply of his city sold raw."

JOSEPH G. GEIGER, M. D., Director of Public Health, San Francisco, California; "Pasteurization of milk, as an added safety factor, has been required of all milk in San Francisco except certified milk which constitutes less than 1% of the total. The results of pasteurization in San Francisco has been so startling in the reduction of infant mortality and in the reduction of milk-borne diseases, that the San Francisco Department of Public Health is recommending to the California Legislature that appropriate legislation be passed to provide for compulsory pasteurization on a state wide basis, in all communities of more than 5,000 population."

JOHN R. RICE, M. D., Commissioner of Health, New York City: "New York receives 2,500,000 quarts of milk a day. Of this 98% is pasteurized and the remaining 2% is certified. I get a great deal of comfort in knowing that our milk supply is well safe guarded through pasteurization. We, in this city, are wholeheartedly in favor of the general pasteurization of the milk supply."

J. W. BASS, M. D., Health Officer, Dallas Texas: "The Health Department of the City of Dallas has always advocated the pasteurization of all milk. In my opinion, even certified milk should be pasteurized."

A. S. FELL, M. D., Director of Health, Trenton, N. J. "All milk or cream sold in Trenton must be pasteurized. This law became effective July 1st, 1931."

B. B. JAFFA, M. D., Health Officer of Denver, Colorado:

"Since 1931 all milk sold in the City and County of Denver must be pasteurized. We carried this fight to the Supreme Court. Since its passage, I believe I am safe in saying that not a single case of disease has been traceable to milk purchased in this city."

F.K. HARDER, M. D., Acting Health Commissioner, Cincinnati, Ohio:

"All milk sold in Cincinnati, including certified, must be pasteurized. We feel that pasteurization is a very important factor of safety, even when the production of the milk is very carefully supervised."

HENRY F. VAUGHN, Dr. P.H., Detroit, Michigan: "I am a strong advocate of the policy that all milk should be pasteurized. The only milk which remains unpasteurized is certified milk and there is little demand for certified milk in Detroit area. A few weeks ago, both the Wayne county Medical Commission and the Detroit Board of Health passed a resolution requiring that certified milk be pasteurized. As soon as this new requirement becomes effective we will have 100% pasteurization. At present we have 99.97 pasteurization."

HUNTINGTON WILLIAMS, M. D., Commissioner of Health, Baltimore, Maryland: "The absence of milk borne communicable disease outbreaks is the most conspicuous characteristic of communities where the milk supply is completely and properly pasteurized. Next to a pure drinking water supply, there is no greater protection of the people's health than a completely pasteurized milk supply."

JOHN P. KOEHLER, M. D., Commissioner of Health, Milwaukee, Wis.: "99½% of Milwaukee's milk supply is pasteurized. The other one half percent is certified. I expect to amend the ordinance so that all milk will be pasteurized."

WILLIAM B. KEELER, M.D., Health Commissioner, Boston, Mass.,

"99.8% of all milk sold in Boston is pasteurized. We feel that even our certified milk is not so safe but that pasteurization would make it distinctly safer. The larger the city, the more important are these facts in relation to the milk supply."

RAY P. MOYER, M.D., Director of Public Health, Pittsburgh, Pa.,

"99½% of our milk supply is pasteurized. All raw milk must have their herds tuberculin and blood tested."

JOSEPH F. BREDECK, M. D., Health Commissioner, St. Louis, Mo.,

"St. Louis has no raw milk sold within its boundaries, except certified. I do not believe any community is justified in permitting raw milk to be sold."

DR. MILLARD KNOWLTON, Director, Bureau of Preventable Diseases,

Connecticut. State Health Department, "A community where the milk is pasteurized will enjoy a sense of security against the dangers of milk borne diseases."

DR. J. MOORE CAMPBELL, Director, Bureau of Communicable Disease, Pennsylvania State Health Department, "Raw milk of whatever grade may transmit diseases. Pasteurization makes milk safe.

GEORGE PARRISH, M. D., Los Angeles City Health Officer, in his book written in 1927, "Health, the Paramount Asset" says, "Pasteurized milk is the safest milk known. All milk should be pasteurized, except possibly certified milk. In the near future, even certified milk will be pasteurized."

FRANCES E. FRONCZAK, M.D., Health Commissioner, Buffalo, N. Y., "We have had compulsory pasteurization of milk and cream in this city since 1918. Even our certified milk is now being pasteurized. Pasteurization is the strongest safeguard we can place around milk and cream, and the local dealers would not go back to the sale of raw milk and cream."

WILLIAM HUNSICKER, M.D., Director of Public Health, Philadelphia, "Less than one percent of fluid milk sold in this city is in the raw state. The raw milk sold is done so under regulations equivalent to those for certified milk."

F. E. HARRINGTON, M.D., Health Commissioner, Minneapolis, Minn., "Minneapolis tried to have all its milk pasteurized, but its proposed ordinance was defective and was declared unconstitutional."

H. G. MORGAN, M.D., Secretary, Department of Health, Indianapolis, "Indianapolis has had pasteurized milk since 1916. Since the advent of compulsory pasteurization, we have not had a milk borne epidemic, streptococci, typhoid fever or milk sickness."

W. A. JONES, M. D., Commissioner of Health, Riverside, Calif., "I am in favor of the use of pasteurized milk by all. It is the only assurance that we have against milk-borne diseases. The use of pasteurized milk should decrease by 50% infant mortality under two years of age."

JOE SMITH, M.D., Health Officer, Kern County, California, "We have been working towards a goal of 100% pasteurization to all milk to be sold in Kern County."

C. MATTHEWSON, M.D., Health Officer, Fresno, California, "since 1930 no milk other than certified or pasteurized has been sold in our city. I feel that all other cities should do the same."

G. E. McDONALD, M.D., Health Officer, Long Beach, California: "It is my belief that the time will come in the not too distant future that all cities will make pasteurization a requirement. We have ample proof that raw milk is the cause of outbreaks of communicable diseases throughout the country."

WHAT LOS ANGELES DOCTORS THINK OF MILK

HENRY F. GALLAGHER, M.D., "I am firmly convinced that whenever possible only pasteurized or certified milk should be available for the general public."

SILAS A. LEWIS, M.D., "In these days when laboratories prove raw milk a carrier of communicable disease organisms, Why don't you put up a fight for the use of pasteurized and certified milk only? This is your duty and certainly would receive the backing of all intelligent people."

WILLIAM H. LEAKE, M.D., "Every physician who has been in active practice for any length of time has encountered illness traced to raw milk. I feel it is highly important for Los Angeles to adopt an ordinance requiring all milk to be certified or pasteurized."

JOHN C. RUDDOCK, M.D., "As time goes on, the list of milk-borne diseases apparently seems to be increasing, and it is only by means of such measures -- certified or pasteurized -- that we may hope to control certain of our communicable diseases."

BEN F. FEINGOLD, M.D., "Legislation which will bar out of this city all milk, except certified or pasteurized, will decrease the incidence of such diseases as typhoid fever, undulant fever, and scarlet fever which are so frequently milk-borne."

E. EARL MOODY, M.D., "There is no place in the diet of the human family for raw milk. The dangers of Malta fever and other infections are too great unless the raw milk has had the benefit of being produced under conditions laid down for certified milk. I would even go so far as to believe, with many other physicians, that even certified milk should have the benefit of pasteurization."

GEORGE H. KRESS, M.D., Noted Oculist and Editor of California and Western Medicine, "I have long been of the opinion that all milk other than certified should be pasteurized. As regards certified milk, I believe its production and distribution should be so carefully supervised that it would be as safe as it is possible to make it."

WILLIAM M. HAPP, M.D., Pediatrician, "I have always insisted that my parents use either certified or pasteurized milk and I caution them against the use of any milk which is not pasteurized."

WALLACE DODGE, M.D., Chief Surgeon, Georgia Street Receiving Hospital, "In this procedure, pasteurization, is made routine, I am sure it will cause a marked reduction in communicable diseases which are now seen only too frequently."

DONALD J. FRICK, M.D., "I have been fully convinced for a number of years that all milk sold for human consumption should be either pasteurized or certified."

JOHN V. BARROW, M.D., "Until we force the use of certified or pasteurized milk on all our major communities, we may expect to have more than civilization's share of outbreaks of communicable diseases."

BARNETT LIPSON, M.D., "The infant mortality rate from gastrointestinal infections has dropped dramatically since pasteurization has come into vogue. As a pediatrician I believe raw, uncertified milk is dangerous and has no place in an infants diet."

ROBERT W. MEALS, M.D., "Our experience has been that a large number of cases can be traced to infected milk, particularly undulant fever and typhoid, both seriously debilitating and highly communicable diseases. It has been shown that pasteurization does not destroy the vitamins or other beneficent qualities of milk and I cannot urge you too strongly to push this vital legislation."

CHARLES R. PARRISH, M.D., "I am heartily in accord with certified or pasteurized milk in all cities. These measures will definitely reduce some of our communicable diseases."

A. J. SCOTT, M.D., "As a pediatrician I do not use any kind of milk except certified or pasteurized. The dangers to health from the use of raw, uncertified milk are too numerous to mention and generally acknowledge. There should be a national law forbidding the sale of any milk except pasteurized or certified."

JOHN W. SHUMAN, M.D., "Certification or pasteurization of milk is a stride in evolution forward."

EDWIN F. PATTON, M.D., "Barring milk which is not certified or pasteurized from the market is good sense. Not only will it benefit humanity but it will be of economic benefit in the prevention of costly diseases."

LLEWELLYN R. LEWIS, M.D., "Any measures, pasteurized or certified, designed to protect the babies against milk-borne diseases, should be enacted."

ROBERT E. RAMSEY, M. D., "Knowing how impure milk can spread and carry diseases, we must insist on pasteurization of all milk other than certified."

WILLIAM E. BRANCH, M.D., "A law compelling the pasteurization of all raw milk, except certified, would be a step further on the road of conquering preventable diseases."

ROBERT W. LANGLEY, M.D., "In my opinion, a law compelling the use of either certified or pasteurized milk would be one of the greatest safeguards to public health that could be introduced in this city."

VICTOR STORK, M.D., Pediatrician, "For some years, I have urged the use among my patients, of either pasteurized or certified milk and have frowned on all the special and trick varieties which are sold as commercial bait to stimulate sales."

ELIZABETH MASON HOHL, M.D., "I am convinced of the need of taking precautionary measures regarding the use of unpasteurized milk and uncertified milk."

PAUL ROEN, M.D., Diagnosis and Internal Medicine, "The passage of a law by the legislature compelling the use of either certified or pasteurized milk would have much to do with the prevention of communicable diseases."

HARLAN SHOEMAKER, M.D., President of the County Medical Society, "There should be but two types of milk--pasteurized and certified. There is a necessity of controlling the milk supply of a city, particularly when the supply comes from so many parts of the state and is produced under a variety of conditions."

CHARLES T. STURGEON, M.D., "I feel a law compelling pasteurization would be a step forward for Los Angeles as it is only in this way that such diseases as typhoid fever, undulant fever and other communicable diseases, can be controlled."

LUCILE G. HARTWIG, M.D., "An ordinance prohibiting the sale of raw milk, other than certified is highly desirable."

EDWIN O. PALMER, M.D., "I am heartily in favor of protecting our city from the sale of milk other than pasteurized or certified."

ELMER BELT, M.D., Urologist, "It has been my custom to recommend Grade A, pasteurized and certified milk to my patients, especially to those who have young children. Routinely, I advise my patients not to use any raw milk that is not certified, without first boiling it."

GLENN MYERS, M.D., Compton Sanitarium, "Having had two cases of undulant fever in my family, one of protracted length, notwithstanding the fact that the milk was always obtained from one of our best dairies, I am for pasteurization."

CHARLES F. SEBASTIAN, M.D., "There is no doubt in my mind but what the fundamental protection of our children rests securely upon a milk supply that is free from communicable diseases. Every community should adopt strict regulations in pasteurization."

EARL M. TARR, M.D., "any regulation which proposes to remove from the reach of innocent and unsuspecting children such an unnecessary health hazard as raw milk will at once command the support of everyone who is courageous enough to face facts. The safest milk obtainable today is pasteurized and certified."

PHILLIP STEPHENS, M.D., Past President, County Medical Society, "As a citizen I am interested in pure, safe, and nutritious food. As a doctor, I know there are only two safe milks, the one is

certified and the other pasteurized."

ETTA GRAY, M.D., "I am heartily in favor of an ordinance in our city which would prohibit any raw milk from being distributed. I personally believe that certified milk too would be better if it were pasteurized."

JOHN G. POMEROY, M.D., Los Angeles County Health Officer; "In the growing number of undulant fever cases, in our territory, most of them traceable to raw milk, we have a patent argument in favor of pasteurization." (See Dr. Pomero's Annual Report, 1934-35, Page 138)

E. VINCENT ASKEY, M.D., Secretary-Treasurer, Los Angeles County Medical Society: "Personally I feel that any raw milk which is not certified is a dangerous thing from the public health standpoint. I am in favor of all milk, except certified, being pasteurized."

MAURICE KAHN, M.D., "I am most emphatically in favor of an ordinance which will compel pasteurization of milk."

LYLE G. McNEILE, M.D., "I have never failed to warn the mothers to accept no milk except certified or pasteurized for their own use or for the use of the children. The dangers of raw milk are so well recognized that I cannot conceive of any opposition to such an ordinance except from uninformed persons."

W. H. Kiger, M.D., "A law compelling all milk to be pasteurized or certified would reduce the occurrence of many communicable diseases."

OSCAR REISS, M.D., Associate Professor Pediatrics, University of Southern California Medical School, "Certified milk is the only raw milk that is safe for human consumption. There should be only two types of milk on the market, certified and pasteurized."

PERCY T. MAGAN, M. D., President, College of Medical Evangelists: "All milk, other than certified, should be pasteurized. I favor such an ordinance."

DONALD CASS, M.D. (Drs. Dickey & Cass): "It is a mark of progress of modern civilization to see the trend toward certified and pasteurized milk. The community should have this protection."

CARL R. HOWSON, M. D., "There are a number of angles to the situation which I would like to discuss with you." (Dr. Howson expressed no opinion.)

P. BERMAN, M.D., Medical Director, Los Angeles General Hospital: "Pasteurization or certified milk would remove one important potential factor in the spread of communicable diseases."

ALBERT G. BOWER, M.D., "Milk is an ideal food for human beings; it is also an ideal food for bacteria. I am in heartiest accord with any program to pasteurize or certify the city's milk supply."

DRS. HENRY DIETRICH, HUGH K. BEMLEY, FRED GLASSCOCK, AND NORMAN K. NIXON, Pediatricians, "We are heartily in favor of the exclusion of all milk, other than certified or pasteurized, for public consumption. Until this is made a law, a local city ordinance to permit the sale in Los Angeles of certified or pasteurized milk only, would receive the unqualified approval of most pediatricians and all interested in this important public health measure."

SVEN LOKRANTZ, M.D., Director of the School Health Department of Los Angeles, "I feel that any advantage which might accrue from the use of raw milk is more than outweighed by the danger of spreading communicable diseases through this medium."

ROSS-LOOS MEDICAL GROUP, "We have in our files hundreds of cases of illness, and severe illnesses at that, that can be directly traceable to raw milk. Pasteurization is a matter of vital importance to the health of our entire community, especially our babies."

CLIFFORD A. WRIGHT, M. D., Endocrinologist, "Inasmuch as so many diseases may be transmitted through improper handling of milk, it is my opinion that an ordinance should be passed which will bar all milk from Los Angeles except that which is certified or pasteurized."

EDWARD M. PALLETTE, M. D., "I think that in all cities of 5,000 or over, and especially in a city as large as ours, all milk should be either certified or pasteurized."

LOUIS I. SOKOL, M. D., "All milk should be either certified or pasteurized. You may expect my cooperation and support toward getting an ordinance to this effect."

DR. JOHN McLEAN: "Many years of experience as a physician and surgeon have convinced me that there are only two kinds of milk that are safe, pasteurized and certified."

OSTEOPATHS

DR. W. CURTIS BRIGHAM, "A great number of milk borne infections appear each year. It is my opinion that if only certified or pasteurized milk were used many cases of acute and chronic illness would not occur."

DR. ERNEST G. BASHOR, Board of Osteopathic Examiners, State of California, "Since the evidence is preponderant in showing that raw milk causes many diseases that might be prevented, it is only fair and just that we should urge the passage of such necessary measures to limit the supply of milk to certified or pasteurized."

DR. CARLE H. PHINNEY, College of Osteopathic Physicians and Surgeons: "Announcement has been made that Doctor Joseph Geiger, San Francisco Health Officer contemplates an introduction of a Bill at the next legislature to compel cities having a population of 5,000 or over to use either certified or pasteurized. Such a law would be of estimable value in protecting the residents of any city or particularly children from such diseases as are milk borne."

SOME HISTORY OF EPIDEMICS

During the past twenty years there has been an average, in America, of one case a week of a milk-borne epidemic of disease. Before that they were more frequent. These outbreaks, with their resultant deaths, demonstrated the death roll part played by raw milk and compelled the unanimous opinion among health authorities that all milk should be pasteurized.

A FEW EPIDEMICS CHOSEN AT RANDOM

Between 1906 and 1926, there were recorded in the United States 479 epidemics of typhoid fever. Typhoid bacilli may swarm in milk without altering its taste, odor or appearance.

The first milk outbreak of septic sore throat occurred near Boston in May 1911. There were 2,000 cases and approximately 50 deaths. The milk incriminated had always been a particularly clean, fresh and satisfactory supply. For years not a breath of suspicion was attached to it until this catastrophe occurred. It emphasized the fact that raw milk is always dangerous. Pasteurization will prevent such a recurrence.

Another instructive outbreak of septic sore throat, reported by Benson and Sears, occurred in Portland, Oregon, in March, 1922. There were 487 cases and 22 deaths. They were all traced to raw milk which came from a first class dairy. This is a common story. Pasteurization will prevent such a recurrence.

The United States Public Health Service reports 50 epidemics of milk borne disease in 1929, as follows:

	No. of Epidemics	No. of Cases	Deaths
Para-Typhoid Fever..	1	38	1
Typhoid Fever	28	528	36
Scarlet Fever	11	1052	1
Septic Sore Throat..	8	939	13
Dysentery.....	1	8	
Food Poisoning	1	24	
	<hr/> 50	<hr/> 2589	<hr/> 51

There is a similarity between all the years for milk-borne epidemics. For instance, see 1930. Forty-eight epidemics were reported.

	No. of Epidemics	No. of Cases	No. of Deaths
Typhoid Fever	30	575	41
Scarlet Fever	2	42	
Septic Sore Throat...	9	1116	7
Gastro-Enteritis ...	3	46	
Dysentery	1	64	2
Enteritis	1	22	6
Food Poisoning	2	103	—
	48	1968	56
1931----			
Typhoid Fever	21	217	16
Para-Typhoid	1	22	
Scarlet Fever	1	9	
Septic Sore Throat..	6	993	8
Streptococcus			
Sore Throat	2	27	
Diphtheria	1	22	
Dysentery	1	65	
Gastro-Enteritis ...	1	13	
	34	1368	24
1932----			
Typhoid Fever	23	251	22
Septic Sore Throat ..	3	148	3
Scarlet Fever	6	207	3
Gastro-Enteritis ...	1	32	
	33	638	28
1933----			
Typhoid Fever	25	299	26
Para-Typhoid	1	17	
Diphtheria	2	19	3
Septic Sore Throat..	7	515	5
Scarlet Fever	3	238	4
Milk Sickness	2	10	1
Udder Cocci	2	250	
	42	1348	39
1934----			
Typhoid Fever	26	299	27
Para-Typhoid Fever..	1	400	
Scarlet Fever	2	39	1
Septic Sore Throat..	8	557	13
" " " and			
Mixed Scarlet Fever.	1	92	1
Gastro-Enteritis ...	3	125	
Diphtheria	1	9	
Staphylococci Food			
Poisoning	3	220	—
	45	1741	42

In addition to the deaths that are caused by drinking raw milk stop and think of the terrific economic or financial loss caused each year as approximately 2,000 people are annually made desperately ill from the use of raw milk. These 2,000 people recover but think of the mental and physical suffering they pass through --- suffering that could have been avoided. The loss of salaries plus the actual outlay for hospitals, doctors, nurses and medicines runs well over a million dollars.

INFANTILE PARALYSIS

In at least three instances it seems to be demonstrated that raw milk was the avenue through which the virus of infantile paralysis was spread. One of these was reported by Dr. John C. Dingeman at Spring Valley, New York (New York State Journal of Medicine, 1916); second, by Doctors A. C. Knapp, E. S. Godfrey, and W. L. Aycock at Courtland, New York, (Journal A.M.A. 1926); and the third by W. L. Aycock (American Journal of Hygiene). Since then, much confirmatory evidence has been gathered. Simon Flexner and Paul Lewis of the Rockefeller Institute tested the virus of infantile paralysis and found that pasteurization renders it incapable of causing paralysis. Pasteurization will prevent such a recurrence.

In March, 1932, the Michigan Department of Agriculture issued the following statement, "A milk-borne typhoid outbreak resulting in twelve cases and one death occurred recently at Yale, Michigan. This outbreak is another argument against raw milk."

During approximately one month in 1927 -- fifty cases of typhoid fever occurred in the towns of Lincoln, Concord and Weston, Mass. and all of these but one were definitely traced to raw milk. An undiscovered typhoid carrier working in the dairy which supplied the milk, caused the outbreak. Pasteurization will prevent such a recurrence.

In 1934, forty epidemics, 1342 cases, and forty-four deaths occurred in eighteen states. Twenty-one of the epidemics were of typhoid fever; nine of septic sore throat; while 4 gastroenteritis; 3 scarlet fever; 2 undulant fever; and 1 diphtheria made up the balance. All except one were traced to raw milk. The one was doubtful. Pasteurization will prevent such a recurrence.

Public Health News, published by the State of New Jersey, November, 1930, writes, "Sixty-four cases of dysentery which occurred in Hamilton Township were traced to raw milk, two deaths occurred."

Health News, New York State Health Department: "Seventy-two cases of scarlet fever and sore throat occurred in the village of Red Creek, Wayne County, New York, during February 1936. One death occurred, all cases traced to raw milk Dairy."

At Moline, Illinois, early in 1936, there occurred a very extensive scarlet fever epidemic. Up to March, 147 cases had been reported. The conclusions drawn by the investigators are that the epidemic was clearly milk-borne and that the source of the outbreak was a raw milk dairy. This extensive epidemic demonstrates the potential danger that lurks behind unpasteurized milk supplies.

Trenton, New Jersey, May 24, 1936: "Infected raw milk traced to a Bergen County raw dairy, has caused six deaths in the past week and sent more than 200 persons to physicians for treatment of septic sore throat, the State Health Department said today." (Trenton Newspaper) "So far six have died."

In 1934 in New York State, outside of New York City, there were three milk borne epidemics of sore throat and one of scarlet fever; all due to raw milk, besides 250 cases of undulant fever, most of which were traced to raw milk. (New York State Health Department News, March 11, 1935).

American Journal Public Health, July 1935: "At Petersburg, Michigan, population 700, during September, 1934, there occurred an outbreak of streptococci sore throat. One hundred and eighty six were ill and six died. The outbreak due to raw milk was caused by the organisms of scarlet fever."

Many hundreds of epidemics traceable to raw milk might be mentioned. Some of the most noted are:

IN CALIFORNIA IN 1935

The following outbreaks of disease due to the use of raw milk occurred in California in 1935:

In August--In Vallejo there occurred five cases of typhoid fever with one death.

In Turlock, three cases of typhoid fever.

At Selma, 6 cases food-poisoning due to raw milk.

At Escondido, 20 cases food-poisoning due to raw milk.

In the State of California, 150 cases of undulant fever were reported for the year 1935.

The most notorious typhoid epidemic in history was that at Montreal only a few years ago with 5,000 cases and over 500 deaths resulting from failure to pasteurize. Other epidemics were the Chatham typhoid outbreak of 1927 with 109 cases; Kirkland Lake septic sore throat epidemic in 1930 with 457 cases; the St. Catherine epidemic of para-typhoid in 1931 with 487 cases, and the St. Maurice Valley, Quebec outbreak with 527 cases. They are Canadian epidemics, but the United States outbreaks are equally as numerous and just as disastrous.

Many cases of undulant fever are being traced to raw milk. For instance, the report of the United States Public Health Service issued for 1935 says: "In addition to the milk-borne diseases that were reported, the following cases of undulant fever were reported as having probably been transmitted by milk supplies:

NUMBER OF UNDULANT FEVER CASES IN 1935:

New York	222	Pennsylvania	81	Florida	68
California	150	Wisconsin	89	Connecticut...	59
Illinois	144	Kansas	98	Alabama.....	54
Minnesota	113	Michigan	73	Louisiana.....	48
Iowa	112	Ohio	69		

Besides the above cases--every state had its number of undulant fever cases in 1935.

California & Western Medicine, October, 1934: Karl F. Meyer, Ph.D., writes: "In order to appreciate the importance of the undulant fever problem, certain statistical data referring to the State of California may be of interest. During the period January, 1927 to January, 1934, 591 cases of undulant fever have been reported. Although distributed through out the state, the ten southern counties form a solid block reporting 406 cases, or 68% of the total number observed within the boundaries of the State. Los Angeles City is represented with 31% of the total. The histories of these cases are by no means complete, but it is noteworthy that in 50% of the established infections no other possible source other than raw milk is mentioned." If 591 cases were reported, it is probable that three times that number escaped detection and went unreported. Pasteurization would have prevented all of these cases.

NUMBER OF UNDULANT FEVER CASES REPORTED EACH YEAR

No. of Cases		No. of Cases	
1927.....	217	1931	1545
1928	649	1932	1407
1929	1301	1933	1716
1930	1450	1934	2010

Undulant fever tends to be a long continued disabling disease which causes much economic loss of time and suffering and does not often lead immediately to death. There are undoubtedly many instances where it paves the way to a fatal ending from some other infection, which pounces upon the individual who has been worn down by long continued fever. On the other hand, deaths from undulant fever are by no means unknown and have been reported from a considerable number of states. Undulant fever is being spread by infected raw milk.

It has often been pointed out that there is a close analogy between a water supply contaminated with typhoid bacilli and a raw milk supply similarly polluted.

The Illinois Health Messenger in 1931, said: "Milk is now a more important carrier of disease than water. In Illinois, no less than seventeen milk-borne epidemics resulted in 288 cases of typhoid fever, while during the same period of time six water borne epidemics resulted in 437 cases of typhoid. More cases were involved in the water borne outbreaks because the polluted water was consumed by more persons than was the contaminated milk."

Every community, large and small, recognizes its duty and obligation toward supplying pure water. It is equally guilty if it sanctions the sale of unpasteurized milk. There is a wide difference in the difficulties encountered in cities in preventing the spread of typhoid fever by water and milk, respectively. Water supplies are centralized and for the most part are under public control. On the other hand, raw milk supplies reach the city from numerous, widely scattered sources, difficult to control. Pasteurization of milk to correspond with filtration and chlorination of water supplies must come before milk borne diseases are conquered.

NUTRITIONAL ASPECTS OF MILK PASTEURIZATION

Almost all authorities are agreed that there is little, if any, difference between the nutritional value of raw and pasteurized milk.

MILTON ROSENAU, Professor of Preventive Medicine and Hygiene, Harvard Medical School, in his wonderful book, "Preventive Medicine & Hygiene," writes: "Milk heated to 145 degrees F. for thirty minutes (pasteurization) does not undergo any appreciable physical or chemical change. Milk contains but a moderate, variable amount of anti-scorbutic (scurvy) property--Vitamin C. The amount of Vitamin C, depends upon the quantity contained in the feed of the cow. This vitamin is influenced by age and by heat. Vitamin D is not affected by heat. Rickets, therefore, cannot be laid to pasteurization."

Pasteurized milk has everything raw milk has and it is immeasurably safer.

E. V. McCOLLUM, JOHNS-HOPKINS, says: "The evidences of experiment do not show any differences between raw and pasteurized milks. There is no convincing evidence that raw milk, even if it were safe, is superior to pasteurized milk in infant feeding. In infant feeding, a little orange or tomato juice should also be fed for the reason that Vitamin C in milk is variable in amount. As there is not an over abundance of Vitamin C in raw milk, juices should be used anyhow."

THE METROPOLITAN LIFE INSURANCE CO., says: "Pasteurized milk is just as digestible and just as nutritious as raw milk."
(Health Library of the Metropolitan Insurance Company).

CORRY MANN, Noted London authority, says: "Milk pasteurized at temperature of 142 degrees to 154 degrees for thirty minutes is not damaged as food for infants; and no incidence of scurvy was observed over a period of three years in children under two years of age given pasteurized milk without orange juice."

In 1932, the United States Public Health Service made a thorough and reliable study of the effects of pasteurized milk on the growth of children. Two groups aged from ten months to six years were investigated, 1807 having received raw milk and 1886 pasteurized milk, with similar supplementary diets in both groups. There was no difference between the average weights-heights of the two groups. The authors stated that the results demonstrated that the growth promoting capacity of pasteurized milk was not less than that of raw milk. (U.S.P.H.S. Report 47).

ARGUMENTS of the PROPONENTS of RAW MILK

1. Raw milk dealers lay considerable stress upon the destruction of Vitamin C when pasteurized. It is evident that any argument based on the destruction of Vitamin C, by pasteurization is fallacious and cannot be maintained. (See foregoing statements by world's leading authorities.)

2. Equally weak is their argument that pasteurization does not destroy all the disease germs present. (All laboratory tests prove the efficacy of pasteurization.)

3. Some raw milk advocates admit pasteurization does destroy disease germs, but they claim there are considerable toxins left in the milk after the destruction of the germs by the heat. Scientists point out that the subject of toxins is a theoretical one. The only ones manifesting any interest in this connection are the advocates of raw milk, who never substantiate their claims.

4. Equally untenable is the claim that pasteurization makes the mineral content of milk unassimilable. Scientists, dieticians, nutritionists and laboratories, have shown respectively that there is no difference between the nutrition of the raw and unpasteurized milk. The raw milk advocates have proven nothing.

5. The raw milk people say that pasteurization of milk destroys the lactic acid organisms in milk and hence it will not sour. The fallacy of this claim is easily demonstrated. Just take a bottle of pasteurized milk at ordinary room temperature and observe what happens, usually during the second day. As the milk stands, the acid formers grow and cause the milk to sour instead of decompose.

6. Their final argument is that pasteurization is used as a substitute for cleanliness; that dirty milk is pasteurized.

In view of the fact that state laws and city ordinances require that a certain high standard of milk and dairy equipment and cleanliness of cattle and personnel be maintained before the milk is acceptable and permitted to be pasteurized, refutes such statements. Pasteurization does not claim to replace sanitation and common decency. It does not atone for filth and is not used as a redemption process. Let me repeat--pasteurized milk has every virtue that raw milk has, plus the safety that goes with pasteurization.

Thus the arguments and statements of the raw milk proponents crumble when the light of scientific investigation is turned on them. Unsupported statements made to an uninformed and unscientific group of laymen may sound logical and reasonable, but like all untruths or halftruths, must give way before the truth.

7. The raw milk advocates claim that compulsory pasteurization is an attempt of the distributors and the well-to-do dairy men to put the small dairyman out of business.. Such an argument is silly. The majority of the small dealers simply have not kept step with sanitation and hygiene. They not only have neglected their own education covering the subject of common cleanliness, but their equipment, in many instances, does not meet public health standards. Pasteurization will not put a single dairyman out of business, it will only prevent him from bottling it on his premises, because years of experience through out the United States shows it cannot be done there with safety. But should pasteurization put a few of the less fortunate out of business, the question arises "Is it not better to do this than permit them to sell raw milk to innocent mothers and children and scatter tuberculosis, undulant fever, scarlet fever, and many other diseases, as they do so?" It is a question of the dollar against your life, which shall it be?"

No one desires to injure a single dairyman. It will be the duty and the pleasure of the Health Department to do everything it can to counsel with and assist all dairymen--particularly the smaller ones.

"ALL ABOUT MILK"

"Printed and Distributed by the Metropolitan Life Insurance Company for the use of its hundreds of thousands of policyholders."

"Milk is our best all-around food. It is the most perfect food we have. It is also one of the cheapest foods. Milk tastes good; it is easily digested, and is very nourishing. It makes bone, brawn and blood. In fact, the vigor and success of a nation depends largely upon the milk it uses. Like all good things, milk has a few drawbacks, but these are far outweighed by its advantages. Milk makes the ration complete, promotes growth and keeps the body strong."

There is no substitute for it. Save on other things, if you must, but not on milk. Milk is good fuel, because it contains fat and sugar. The body needs fuel to keep it warm and to make it move and work and play. Milk is more than a fuel--it repairs waste, helps growth, build bone and flesh. Milk is rich in vitamins. It contains all the different kinds of vitamins which are essential to life. Milk contains a great deal of lime. Children need plenty of lime, especially for their bones and teeth. Children and adults need lime, because the bones are always wearing away and this wear and tear must be replaced. Milk also contains plenty of phosphates. Milk is an absolute necessity for the growing child. Each child should have a quart of milk a day. Look at the children who do not get milk--pale and sickly; but milk is not only the food of choice for children, it unquestionably is the ideal food for the adults, especially for sick people and persons 45 years or over. After a person reaches middle life his digestive organs slow down, the same as the other organs of the body and assimilation is less active, therefore, their burden must be lightened. That is the time to go back to the foods of childhood. Milk is undoubtedly the best and safest food for these persons who are 45 years of age or older.

"It was found in the Army hospitals that the wounded recovered more quickly when given milk. Milk helps to keep the grown-ups strong, vigorous and young. Milk contains 'life' because it contains vitamins. Vitamins promote growth and favor utilization of food. It is not possible to live without vitamins, even though large quantities of food are eaten. There are several kinds of vitamins. One of them is found in milk fat. Another is found in the watery part of the milk. Milk has everything needed in the diet. It is a complete mixed diet itself. It has sugar and fat which give energy to move the body; it has mineral salts which build up the bones and keep the body in good shape; and albumen (protein) which, like meat and eggs, is important in making brawn and sinew.

"Think of the value of having one food which supplies all the necessary elements of a good mixed diet, and which at the same time can be used without special preparation. In the home, milk should be kept cold, clean and covered. Never let the milk bottle stand around. Have a special place in the coldest part of the refrigerator for the milk bottles. Milk bottles should never be taken into the sick room. Milk bottles should never be used for any other purpose than to hold milk. They should be rinsed in cold water and then washed and scalded before they are returned to the milkman. Inspection and pasteurization solve the milk problem. Milk is the best food.. Use more milk. Make milk the foster mother of your children."

W. A. JONES, M.D., Commissioner of Health, Riverside, California: I am in the favor of the use of pasteurized milk for all. It is the only assurance that we have against milk-borne diseases. The use of pasteurized milk should decrease by 50% infant mortality under two years of age."

HAROLD DEWEY BARNARD, M.D., "After 24 years in the practice of Medicine, I believe the milk supply should be limited to certified and pasteurized milk. This would prove to be a highly efficient protective measure in the limitation of communicable diseases."

PASTEURIZATION OF MILK

FROM THE
 NEW YORK STATE DEPARTMENT OF HEALTH
 EDWARD S. GODFREY, JR., M.D., COMMISSIONER
 BULLETIN M.S.53-1940 EDITION
 ORIGINALLY WRITTEN BY THOMAS PARRAN, JR., M.D.
 NOW SURGEON GENERAL, UNITED STATES PUBLIC HEALTH
 SERVICE

WHAT ABOUT PASTEURIZATION?

The Department has been asked the question, "What about pasteurization?" so many times that it has been decided to discuss the question fully in a circular which can be sent to inquirers. Pasteurization in New York State means heating milk in properly constructed apparatus to a temperature of not less than 143°F. and holding it at that temperature for not less than 30 minutes, or heating it to a higher temperature for a shorter period when apparatus and method are approved by the State Public Health Council. Both the "holding" and the "short-time" methods are in operation in the State.

There is a constantly increasing trend toward pasteurization not only in this state but elsewhere. About 98 per cent or more of the milk supply of the municipalities with a population of 10,000 or over in the State is pasteurized. The proportion in different cities, of course varies, but in most of the large cities very little raw milk is sold. In the rural districts a much smaller proportion is pasteurized. Data indicates that over 98 per cent of the milk sold in New York City is pasteurized, the remainder being certified. In the remainder of the State, reports from health officers, dealers and an estimate of sales in rural areas indicate that approximately 73 per cent of the milk sold is pasteurized. The Department believes thoroughly in efficient pasteurization as a safety measure and has long advocated the enactment of municipal regulations, wherever feasible, requiring the pasteurization of milk.

It is said that Abraham Lincoln, in presenting a case to a jury, followed the plan of presenting his opponent's probable arguments and disposing of them before presenting his own case. Following the method of the "Great Emancipator," before setting forth the reasons for pasteurization we will present and answer the

ARGUMENTS AGAINST
 PASTEURIZATION

There are, of course, arguments against pasteurization, as there are against practically all propositions which involve the interest of large numbers of people and special groups of individuals. We have endeavored to collect and answer all that have come to our attention, even though some are relatively unimportant.

ARGUMENT NO. 1: Pasteurized milk has a "cooked taste."

ANSWER: The "cooked taste" when it occurs, is due to overheating. Pasteurization by the older methods frequently caused a cooked taste, but with modern apparatus the process can be so controlled that flavor need not be affected. If the milk is held at just the right temperature for the right time in proper equipment, even experts can not distinguish pasteurized from raw milk by the taste. At a dinner attended by about one hundred dairy and milk inspectors and other milk experts in Harrisburg, Pa., milk was served. Those present were asked to "vote" as to whether it was pasteurized or raw. The vote was about evenly divided. The milk had been pasteurized at 145° - two degrees higher than the New York State requirement. While the "cooked taste" is objectionable to some people, it is better to have the milk overheated than underheated.

ARGUMENT NO. 2: Pasteurization reduces the "cream line" or "cream volume."

ANSWER: Investigators have found that the volume of cream rising to the surface on a bottle of milk, or so-called "cream line" is not materially affected by heating to temperatures below 145° for 30 minutes. The prescribed time and temperature relationships in New York State are not less than 30 minutes at 143° F. or more, and not less than 15 seconds at 160° F. or more. If the temperatures rise above those prescribed, as they may occasionally do, there may be a slight reduction in the "cream-line." Obviously this does not mean that any cream has been taken out of the milk but rather that some of the cream does not rise to the top.

ARGUMENT NO. 3: In raw milk the vitamins are intact.

ANSWER: The inference here is that vitamins are destroyed by pasteurization and if this were so it would be important in infant feeding. The facts seem to be that of the several vitamins present in milk only one, Vitamin C which prevents scurvy, may be diminished in quantity. However, this vitamin is present in raw milk in such small and uncertain quantities that milk cannot be depended on to supply the infant with the necessary quantity. Vitamin C is present in larger and more certain quantities in orange juice and other fruit or vegetable juices which are now generally used in connection with infant feeding.

ARGUMENT NO. 4: Pasteurization takes the "life" out of milk.

ANSWER: So far as this argument relates to vitamins it has already been answered. Referring to the so-called enzymes, which as Rosenau says in his book, "The Milk Question", "are the nearest approach to life with which we are familiar in milk," Phelps (Public Health Engineering) presents a chart prepared by Dr. Charles E. North which seems to indicate that a temperature of over 144° for 30 minutes is required before the enzymes are destroyed. Recent evidence shows that an enzyme known as phosphatase is destroyed by pasteurization. However, we know of no evidence that the presence of this enzyme adds anything to the food value of milk. At any rate pasteurization, as Prof. Rosenau says, "does not devitalize milk any more than cooking devitalizes meat, vegetables or cereals."

ARGUMENT NO. 5: Children and invalids "do better on raw milk than on pasteurized.

ANSWER: Scott and Erf in 1931 reported the results of a study made at Ohio State University, in which white rats were fed on milk from a herd of cows receiving a special ration to which certain minerals had been added. The rats fed upon this milk after pasteurization showed a less satisfactory growth and considerable anemia, as compared with a similar group fed upon the same milk unpasteurized. Dr. Scott, a pediatrician, presenting a paper on this experiment before a group of milk control officials expressed the opinion that the results did not affect the desirability of pasteurizing the "ordinary market milk" for general use.

Krause and others, working at the Ohio State Agricultural Experiment Station, later made a somewhat similar study using white rats but feeding them on milk from a herd receiving an ordinary standard dairy ration. They reported that there was no material difference as to development and physical condition, between those fed on raw and pasteurized milk. They found that rats fed exclusively on raw milk over a considerable period invariably developed anemia, but that this did not occur when small amounts of iron and copper were added to the milk.

Frank, of the United States Public Health Service, in Public Health Reports for September 23, 1932, reports the results of a survey which furnished convincing evidence that

"The growth-promoting capacity of heated milk plus the supplementary diet received by the average American child of 10 months to 6 years is not measurably less than the growth-promoting capacity of raw milk plus the supplementary diet received by the average American child of 10 months to 6 years."

Surveys were made by state health departments of 10 states, covering approximately 3700 children between the ages of 10 months and 6 years, about half of whom had received no milk except heated milk, the other half having received raw milk for "more than the latter half of their lives." No significant

difference was found between the average weights and heights of the children in the two groups. "The parents of the children receiving predominantly raw milk reported a higher incidence of diphtheria, scarlet fever, intestinal disturbances, and rickets than did the parents of the children receiving heated milk only."

The evidence on this point speaks for itself.

ARGUMENT NO. 6: The mineral content of milk may be reduced by pasteurization.

ANSWER: Mattick and Hallett in the Journal of Agricultural Science, 1929 under the head of "Effect of Heat on Milk" reported results of experiments bearing on this point. "It is obvious," they said, "that the total amounts of calcium, phosphorus and nitrogen in milk cannot be altered by the application of heat, although the differences observed in heated milk render it probable that some change in the solubility of one or more of their salts may be affected." Carefully controlled experiments were made to determine just what these changes, if any were.

Heating for 20 minutes at various temperatures, they found no "significant differences" in the amounts of diffusible nitrogen at any of the temperatures and none in diffusible phosphorus at temperatures below 175°F., but "the amount of total calcium which becomes indiffusible is... about 2 per cent." This is of interest from a scientific standpoint, but so far as the nutritive value of milk is concerned this relatively slight change probably is unimportant, especially as milk is only one of several common sources of calcium salts.

ARGUMENT NO. 7: Cooked milk is likely to be constipating.

ANSWER: First of all, pasteurized milk is not "cooked milk." The prescribed temperatures are far below the boiling point. Pasteurized milk is no more likely to be constipating than is raw milk. In fact a prominent pediatrician (specialist in children's diseases) who prescribes boiled milk frequently for babies states that constipation occurs no more frequently among babies fed on boiled milk than among those fed at the breast.

ARGUMENT NO. 8: There are certain physicians who recommend raw milk for babies in preference to pasteurized.

ANSWER: Having answered the four preceding arguments there is little more that needs to be said in answer to this argument. Universal agreement on a matter of this kind would be too much to expect. Some time ago a questionnaire was sent to a number of the most prominent pediatricians in the country asking whether they preferred pasteurized or raw milk for infant feeding. Only a very small minority favored raw milk. Although we have made no canvass of general practitioners on this question we believe that a large majority would vote for pasteurized milk.

ARGUMENT NO. 9: Pasteurization is an excuse for the sale of dirty milk.

ANSWER: There was a time, years ago, when this probably was true in many instances. For the past twenty-four years, however, the State Sanitary Code has prescribed definite standards of sanitary quality for raw milk which is to be pasteurized. If the health officers are doing their duty in enforcing the code requirements, "dirty milk" can not be pasteurized. In fact, standards of cleanliness among dairymen and milk dealers are much higher today than they were in the early days. Furthermore, while dirty milk, whether raw or pasteurized, should not be tolerated, even such milk--if effectively pasteurized--probably would be safer so far as the dissemination of communicable diseases is concerned than the "general run" of raw milk. A survey made in New York State in 1930 revealed the fact that milk being delivered to pasteurizing plants compared favorably, as to average bacterial content, with that sold as raw milk.

ARGUMENT NO. 10: Pasteurization may be carelessly done. It is therefore not infallible.

ANSWER: It is obviously true that either raw or pasteurized milk may be carelessly handled. Pasteurizing plants in New York State, however, have for many years been inspected both by state and local health departments, and the efficiency both of apparatus and methods is constantly increasing. Notwithstanding the relative inefficiency that prevailed in the past, our record of milkborne communicable disease (to be referred to in detail later) indicates that even then pasteurized milk was much safer than raw milk.

ARGUMENT NO. 11: Pasteurization destroys the souring bacteria so that milk instead of souring normally will putrefy if kept long enough.

ANSWER: Fortunately pasteurization does destroy many but not all of the "souring" bacteria, most of which gets into the milk with dirt, and this accounts for the fact that pasteurized milk usually keep longer than raw milk. Few people are likely to worry because their milk keeps sweet too long. Not all these bacteria are destroyed and the milk does sour "normally", if usually somewhat less quickly than raw milk.

ARGUMENT NO. 12: The toxins formed by disease bacteria may not be destroyed by pasteurization, or possibly dangerous substances might be formed by destruction of other bacteria.

ANSWER: There is a question whether the toxins formed by virulent hemolytic streptococci would be destroyed or rendered innocuous by pasteurization. Dr. Ruth Gilbert of the Division of Laboratories and Research says, however:

"I have never seen a report of an epidemic of septic sore throat traced to the use of properly pasteurized milk. One would not expect serious illness to result from the pre-formed toxins that might be in the milk if living bacteria were not present. Thus, as far as experience and the literature would indicate, hemolytic streptococci in milk are a menace only in case the organisms are alive, the symptoms resulting from ingestion being due to infections rather than toxemias."

The important point, of course, is that if these or other disease organisms find their way into milk they will be killed by efficient pasteurization and they are certainly less dangerous when dead than when alive.

As for the possibility of "dangerous substances" being formed by destruction of bacteria other than those which incite disease, there is no evidence that this occurs. If they are dangerous at any time they, like the pathogenic (disease inciting) bacteria, are less dangerous when they are dead.

ARGUMENT NO. 13: Pasteurization is unnecessary in "the country" where milk goes directly and promptly from producer to consumer.

ANSWER: This argument is based upon a popular impression which experience has proved to be entirely fallacious. It is, of course, desirable that milk be fresh, but the slight delay incident to shipping it a reasonable distance and pasteurizing it is a matter of little moment, providing that it is good milk to start with, is kept cold and otherwise properly handled. A more important consideration is that of the transmission of infection. Our records of milkborne communicable disease (to be discussed in more detail later) indicate that in this State in the past twenty-three years:

(1) a large majority of milkborne outbreaks occurred primarily outside of cities, and

(2) in over 91 per cent of the outbreaks the sources of infection were on the farms.

Naturally the farms are in "the country." It is therefore clear that the proximity to the farms affords no protection; in fact, if, for example, a typhoid carrier or a diseased cow on the farm infects the milk, the more promptly and directly the consumer gets the milk the greater is the likelihood of the germs still being active and virulent and of the consumer becoming infected.

ARGUMENT NO. 14: Pasteurization will increase the price of milk.

ANSWER: It has been determined that where milk is pasteurized in large quantities, the additional cost to the dealer, figuring in the cost of apparatus, depreciation, "up-keep" and labor, is a fraction of a cent per quart. Naturally the smaller the quantity of milk handled the greater is the "overhead" and for the small dealer the cost probably will approximate a cent a quart. From the standpoint of safety efficiently pasteurized milk as compared with the same milk in its raw state is easily worth a cent or two more a quart.

In these days people buy insurance against all sorts of contingencies: death, accident, sickness, fire, burglary and "what not." The consumer who pays the additional cent or two a quart for efficiently pasteurized milk is buying cheap and effective insurance against milkborne infection.

To people in moderate or poor circumstances, particularly when they have large families to "raise and educate", even the addition of a few cents a week is an important consideration. However, if their families happen to be among the victims of milkborne infection the cost to them in a period of a few weeks probably will vastly exceed the additional cost incident to obtaining pasteurized milk over an equal number of years. Even conceding that their chances of becoming infected are relatively small, this is still an important consideration.

The three following arguments apply particularly to municipalities considering the enactment of ordinances or regulations requiring the pasteurization of milk.

ARGUMENT NO. 15: There are always some people who "demand raw milk."

ANSWER: It is a trait of human nature to "want what we want when we want it." Some motorists for a time demand the right to cross railroads ahead of approaching trains and to pass cars on the curves; parents have been known to demand the right to send their children suffering from whooping cough to school. While these "demands" admittedly are not in quite the same category as that for raw milk, they serve to illustrate the point that there are situations which "demands" that some individual or body of individuals be given authority to take such action as may be necessary to protect the interests and safety of the community which, after all, is but a group of individuals. Many people who demand raw milk do so because they have not taken the trouble to inform themselves on the relative virtues of raw and pasteurized milk or because they have been misinformed. The person who contracts a disease such as typhoid fever or scarlet fever from milk or otherwise, becomes a potential source of danger to others. A milkborne epidemic in any community hurts business and gives the community

a "black eye." In order that the safety and interests of the community as a whole may be protected, local authorities are wisely given power to enact such ordinances or regulations as may be necessary for the protection of public health. In exerting such authority they rarely act unreasonably or arbitrarily. In many places, as in New York City, the demand for raw milk has been met by permitting the sale of Certified milk, a raw milk selling for a comparatively high price because of the extreme precautions taken in its production.

The fact that in the rural area of the State where a relatively large per cent of the milk sold is raw probably accounts for the fact that the majority of our milkborne communicable disease outbreaks have occurred in this area.

ARGUMENT NO. 16: If pasteurization is required many small dealers in raw milk will either have to go to the expense of buying pasteurizing apparatus or go out of business.

ANSWER: This is an argument which is at times given serious consideration. We heartily sympathize with the predicament of the person in any line of business who finds it necessary to put more money into his business in order to keep up with the march of progress or to meet competition and finds it difficult to raise the money. On the other hand, this is one of the exigencies which a person in any business must be prepared to meet. As Harry Walker Hepburn says in his "Psychology in Modern Business," the business man, "like the savage...must occasionally 'put his ear to the ground' to get the tendencies of the times and then prepare to meet them. His guiding attitude must be that of expecting changes and preparing to meet them." Furthermore, the financial interests of any individual or group cannot properly be weighed against the protection of the community as a whole.

There is, moreover, another side often overlooked. Many milk dealers who have started pasteurizing "with fear and trembling" have eventually had their business materially increased as a result. One interesting example will suffice. A few years ago a small city suffered from a serious typhoid fever epidemic which proved to be waterborne. Before the source of infection had been announced milk was under more or less suspicion. A milk dealer afterward told this story:

"I was selling raw milk and doing a good business. I was against pasteurization and didn't care who knew it. Then the epidemic came along. One morning I went out on my route and found I had lost seventeen good customers. That settled it; when I got home I got an agent for pasteurizing apparatus on the phone. The next morning he arrived and in a week I was pasteurizing." Then followed the most interesting part of his story. "It took another week to get my new bottle caps, so for a week I was selling pasteurized milk under a "raw" label. The first day I went out with my bottles labeled "Pasteurized" four or five customers looked at the label and said:

'Oh, I don't want pasteurized milk! I don't like the taste of it! 'Well,' I said, 'You've been getting it for a week and didn't know the difference.' The upshot of the matter was that my business increased, I was relieved of a lot of worry and, believe me, I wouldn't go back to raw milk.

In some cities in which pasteurization ordinances have been enacted an increase in per capita consumption of milk, apparently due to increased confidence on the part of consumers, has been noted. For those "producer-dealers" whose business is not large enough to warrant undertaking pasteurization there are other markets, somewhat less satisfactory from their standpoint, but usually adequate. They can deliver their milk to pasteurizing or manufacturing plants.

ARGUMENT NO. 17: In rural communities the quantities of milk sold are so small that pasteurization is impracticable.

ANSWER: So far as the sparsely settled rural community is concerned this argument comes near to being valid than any of the other sixteen. The "overhead" cost of pasteurizing less than two or three hundred quarts is relatively high. The answer, however, is fairly obvious. In these days, of motor transportation most communities are near enough to larger centers of population so that they can easily be reached by dealers who can afford to pasteurize. They will come in if the "business is there." Most people like to "patronize home industries" but they should not forget that in recent years good roads, the automobile and the telephone have pushed back boundary lines so that "home" now covers a much larger area than it once did. There is still another point; the dealer who can not afford to pasteurize, frequently can not (or thinks he can not) afford to take other necessary precautions in the handling of his milk. He should not expect to "set the pace" for the community.

Now having answered these several major and minor arguments, we turn to the

REASONS FOR PASTEURIZATION

In the twenty-three year period between January 1, 1917 and January 1, 1940, 157 milkborne outbreaks of communicable disease occurred in the State, exclusive of New York City, only three of which were traced to pasteurized milk. The total number of cases was at least 9135. The diseases occurring in these outbreaks were typhoid and paratyphoid fever, septic sore throat, scarlet fever, diphtheria, dysentery, poliomyelitis and gastroenteritis.

Of these 157 outbreaks, 75 were typhoid fever (paratyphoid being included here under this head). Fifty-five of the 75 were traced to carriers and 10 to cases on the farms. Many outbreaks of disease other than typhoid fever, which is not generally transmitted through the udder of the cow, have been traced to cows with mastitis. The common form of bovine mastitis is not responsible for outbreaks of scarlet fever and septic

sore throat , but may be involved in outbreaks of gastro-enteritis. This same condition may have been responsible for others where the infected cows were not located. Of the entire 157 outbreaks, about 91 per cent originated on the farms.

Of the 157 outbreaks, 154 were traced to raw milk. Of the three recorded as due to pasteurized milk, one apparently was traced with reasonable certainty to contamination following pasteurization by an employee in the bottling plant who had an unrecognized case of the disease. In another, which occurred early in the twenty-three year period, missed cases of disease on a farm apparently were responsible. In this instance the efficiency of the pasteurizing plant had previously been in question and there is some doubt as to whether the milk was actually pasteurized. In the other case, the milk was labeled Pasteurized although the evidence indicated that it had not been pasteurized.

The foregoing record does not include tuberculosis or undulant fever. It has been estimated that about one-third of the tuberculosis among children is due to use of milk from tubercular cows. Bovine tuberculosis has been reduced to less than one-half of one per cent through tuberculin testing of cattle.

PASTEURIZATION DESTROYS DISEASE BACTERIA. This is the most important reason why milk should be pasteurized. It is scarcely necessary to point out that by no means all cases of communicable disease are chargeable to milk. But the occurrence of over 9000 cases of milkborne infection, not including tuberculosis and undulant fever, in twenty-three years is no small matter. Undulant fever is a seriously incapacitating disease frequently due to the use of raw milk or cream from herds infected with "contagious abortion." Increasing numbers of cases of undulant fever are being discovered in New York State, most of which are believed to have been contracted through the use of raw milk or cream from infected cattle.

There is another important consideration:

PASTEURIZATION HAS CONTRIBUTED TO REDUCTION IN OUR INFANT DEATH RATES. Within the memory of many of us, hundreds of babies died every year, particularly in the large cities from "summer diarrhea." This condition was chiefly due to use of milk containing large numbers of "dirt bacteria," the sort of bacteria that get into the milk with dirt from the cow's skin, unclean utensils and dust. Notwithstanding the general marked improvement in cleanliness of our milk supply in recent years, considerable numbers of such bacteria will still be found in some of our market milk in its raw state. Several factors have contributed to the steady decline in recent years in deaths from diarrheal diseases among babies, but the most important factors have been this general improvement in the cleanliness of the milk supply

and pasteurization, particularly the latter. Pasteurization not only makes milk safer for babies but accounts for the fact that pasteurized milk "keeps" longer than raw milk of similar quality.

The important part of the story might be summed up in the simple statement that

EFFICIENTLY PASTEURIZED
MILK IS SAFE

and

THE SAFEST MILK IS THE BEST

MILKBORNE OUTBREAKS OF DISEASE
NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY

YEAR	DISEASE	OUTBREAKS	CASES	KIND OF MILK RESPONSIBLE
1917	Typhoid fever	3	53	Raw
1918	Typhoid fever	6	114	Raw
1919	Typhoid Fever	5	52	Raw
1920	Typhoid Fever	3	50	Raw
	Diphtheria	1	70	Raw
1921	Typhoid Fever	10	211	Raw
	Scarlet Fever	1	24	Raw
	Dysentery	1	14	Raw
1922	Typhoid Fever	5	69	Raw
	Diphtheria	1	13	Raw
	Scarlet Fever	2	149	Raw
1923	Typhoid Fever	7	83	Raw
	Typhoid Fever	1	23	*Pasteurized
	Septic Sore Throat	1	14	Raw
	Scarlet Fever	1	59	*Pasteurized
1924	Typhoid Fever	6	103	Raw
	Scarlet Fever	1	20	Raw
	Gastroenteritis	1	82	Raw
1925	Typhoid Fever	8	174	Raw
	Diphtheria	1	16	Raw
	Scarlet Fever	2	70	Raw
	Septic Sore Throat	1	¹ 1100	Raw
	Poliomyelitis	1	11	Raw
1926	Typhoid Fever	7	128	Raw
	Diphtheria	2	24	Raw
	Scarlet Fever	2	65	Raw
	Gastroenteritis	2	157	Raw
1927	Typhoid Fever	2	30	Raw
1928	Typhoid Fever	1	7	Raw
	Scarlet Fever	1	31	Raw
	Septic Sore Throat	1	30	Raw
	Gastroenteritis	1	84	Raw
1929	Typhoid Fever	1	² 9	Raw
	Septic Sore Throat	3	² 230	Raw
1930	Septic Sore Throat	3	³ 819	Raw
	Gastroenteritis	2	34	Raw
1931	Typhoid Fever	1	22	Raw
	Septic Sore Throat	3	593	Raw
	Gastroenteritis	1	13	Raw
1932	Typhoid Fever	2	18	Raw
	Scarlet Fever	1	29	Raw
1933	Typhoid Fever	2	9	Raw
	Septic Sore Throat	2	197	Raw
1934	Scarlet Fever	1	92	Raw
	Septic Sore Throat	2	146	Raw
	Gastroenteritis	1	53	Raw

*See page 153

1 Estimated 1100 of which 366 were reported

2 One outbreak of 141 estimated with 115 reported and another of 75 with 51 reported

3 One outbreak of 720 estimated, 88 reported

MILKBORNE OUTBREAKS OF DISEASE
CONTINUED
NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY

YEAR	DISEASE	OUTBREAKS	CASES	KIND OF MILK RESPONSIBLE
1935	Typhoid Fever	1	7	*Pasteurized
	Scarlet Fever	1	5	Raw
	Septic Sore Throat	5	1771	Raw
	Gastroenteritis	4	131	Raw
	Dysentery	1	131	Raw
1936	Typhoid Fever	1	13	Raw
	Scarlet Fever	6	841	Raw
	Septic Sore Throat	2	61	Raw
	Gastroenteritis	1	36	Raw
	Typhoid Fever	2	15	Raw
1937	Scarlet Fever	3	43	Raw
	Gastroenteritis	1	75	Raw
	Typhoid Fever	1	13	Raw
1938	Scarlet Fever	1	14	Raw
	Septic Sore Throat	4	491	Raw
	Gastroenteritis	2	175	Raw
	Dysentery	2	166	Raw
	Scarlet Fever	1	18	Raw
1939	Septic Sore Throat	2	638	Raw
	Gastroenteritis	3	97	Raw

* See page 153

1 One outbreak of 500 estimated, 344 reported and another of 120 estimated, 29 reported.

SUMMARY OF MILKBORNE OUTBREAKS
OF DISEASE
NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY
1917 - 1939

DISEASES	OUTBREAKS	CASES
Typhoid Fever	75	1203
Diphtheria	5	123
Scarlet Fever	24	1460
Septic Sore Throat	29	5090
Dysentery	4	311
Poliomyelitis	1	11
Gastroenteritis	19	937
Total	157	9135

98.0 per cent of outbreaks and 99.0 per cent of cases were traced to raw milk as the source of infection.

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Issued by the Bureau of Milk Sanitation



KANSAS STATE BOARD OF HEALTH
F. P. Helm, M. D., Secretary

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UNDULANT FEVER

The number of cases of undulant fever in Kansas is increasing, with the provisional total of 165 during 1940 greatly exceeding the total for any year since 1927, when first reports of this disease were received by the Kansas State Board of Health. This increase does not necessarily indicate an actual rise in the incidence of the disease -- it is undoubtedly the result of more accurate diagnoses and improved reporting. Undulant fever is transmitted directly by contact with livestock or carcasses of animals infected with contagious abortion, or indirectly by milk from cows infected with this disease. Undulant fever can be prevented by two methods -- true prevention is based upon the detection and elimination of infected animals. The prevention of undulant fever induced by the use of infected milk can be accomplished by pasteurization of raw milk.

The first cases of undulant fever were recognized and reported in Kansas in March, 1927, by Major C. C. Hillman, of the U. S. Army Medical Corps. Major Hillman, who was stationed at Fort Riley, reported the cases in March, 1927, although onset was determined as having been in September, October, and December of 1926. Since, and including the three cases reported in 1927, Kansas has had 1,106 cases with 44 deaths charged to undulant fever; this does not include any deaths which may have occurred in 1940, as mortality tabulations are not yet completed. This disease, obviously, constitutes an important public health problem -- fortunately one for which we know the answer, which is, application of the known means of prevention.

Until a few years ago, this disease was generally called Malta fever, because it was first differentiated from other fevers typical of the Mediterranean coast area, by Marston, a medical officer of the U. S. Army stationed at Malta. Although British medical officers, who had served in Malta after 1800, repeatedly described the occurrence and increasing prevalence of the disease, especially between 1854 and 1860, it was differentiated from other fevers and fully described by Marston in his "Report on Fever" for 1861, and was called, in this report, Mediterranean remittent, or gastric remittent fever.

Studies progressed and Bruce discovered the organism in 1886; isolated it in 1887, and gave it the name "Micrococcus melitensis" in 1893. The name "Brucella melitensis" was proposed in 1920, in honor of the discoverer.

The first case was recognized and reported in America in 1904, and during 1905-'24 inclusive, 128 cases were reported in the United States. Compare this record of 128 cases in the nation in a twenty-year period to the 165 reported in the state of Kansas alone, in the one year 1940. We repeat the earlier observation, that the increase in the number of reported cases of this disease is undoubtedly due to improved diagnosis and reporting. Physicians have learned to identify the disease by its clinical symptoms, with diagnosis confirmed by laboratory tests.

The name "undulant fever" describes the wavelike fluctuations of fever characteristic of the disease.

The number of cases of infantile fever in 1957 was 1,100. This figure is based on the reports of the State Board of Health. This increase does not necessarily indicate an increase in the incidence of the disease -- it is possible that the increase is due to a more accurate diagnosis and improved reporting. The disease is usually caused by contact with infected milk or milk products. The disease is usually reported by two methods -- one by the State Board of Health and the other by the State Department of Health. The disease is usually reported by the use of infected milk or milk products.

The first case of infantile fever was reported in 1957 by Dr. J. H. Hillman, of the U.S. Army Medical Center, who was stationed at Fort Riley, Kansas. The patient was a young girl who was reported as having been in contact with infected milk. The disease is usually reported by two methods -- one by the State Board of Health and the other by the State Department of Health. The disease is usually reported by the use of infected milk or milk products.

Until a few years ago, this disease was reported as "infantile fever". It was first distinguished from other fevers by the U.S. Army Medical Center, who had a report in 1957. The disease is usually reported by two methods -- one by the State Board of Health and the other by the State Department of Health. The disease is usually reported by the use of infected milk or milk products.

Studies progressed and the disease was discovered. The name "infantile fever" was proposed in 1958, in honor of the discoverer.

The first case was reported and reported in 1957. The disease is usually reported by two methods -- one by the State Board of Health and the other by the State Department of Health. The disease is usually reported by the use of infected milk or milk products.

Undulant fever is characterized by three predominating symptoms, namely: (1) general feeling of weakness, especially in the afternoon, accompanied by headache, or general aching; (2) fever, which is usually preceded by a feeling of chilliness, or a definite rigor followed by a hot stage, and (3) profuse sweating.

Onset of the disease may be gradual, and in cases where the attack appears to be sudden, inquiry often reveals a previous stage of fatigue and indigestion. A typical case of undulant fever shows chilliness and a step-like rise of fever on each successive night, profuse night sweats, and lower morning temperatures. This condition continues, generally for six to eight weeks or more, after which the fever gradually declines and reaches normal or subnormal. In some cases the fever may rise again, after several days of normal temperature. Between attacks of fever, the patient, except for weakness, feels normal. With recurrences of fever attacks, lasting for months, the patient becomes anemic and functional heart murmurs may develop. There is also loss of weight, extreme prostration, nervousness, and mental depression. Patients are rarely dangerously ill, and for that reason complete physical and laboratory examination is often neglected.

The diseases most frequently confused with undulant fever are: typhoid fever, tuberculosis, malaria, influenza, heart disease, rheumatism, septicemia, and appendicitis.

Human beings contract undulant fever chiefly by drinking raw milk from infected cows, although farmers, dairymen, veterinarians, packing house employes, and others whose work brings them in contact with cattle, hogs and goats or the carcasses of these animals, also are liable to contract the disease if they handle animals infected with Bang's disease or contagious abortion.

Since the disease is chiefly spread by infected raw milk, Wilson G. Smillie, (pronounced Smiley) one of the outstanding public health authorities of the United States, says -- we quote, "proper pasteurization of milk is the most effective measure in prevention of undulant fever that is available at present." Doctor Smillie continues, "State departments of animal industry have taken active measures in many states, to rid infected herds of Brucella infection. In some districts the infection rate in cattle is very high and elimination of the infection is a slow process. A few dairies that produce certified milk have succeeded in completely eliminating abortus infection from their herds; but the basic preventive measure is milk pasteurization." (end of quote). Testing herds of cattle, with elimination of animals infected with contagious abortion, is an important control measure. Herds are easily infected, and when a farmer or stockman rids his herd of infected animals, he must be on guard against reinfection. Slaughter-house employes and others handling cows, goats or hogs, should wear rubber gloves as a protection against undulant fever.

Undulant fever is an important disease economically -- because it results in much time lost from work, due to its characteristically lengthy course.

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